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CONTENTS

Cover Picture: Muskox, copy of a painting by Allan Brooks
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A New View of the History of the Aleutians. *W. S. Laughlin and G. H. Marsh* 75

Eolian Deposits of Alaska. *Robert F. Black* 89

Notes on the Mammals of the Mackenzie District, Northwest Territories. *A. W. F. Banfield* 113

Remarks on the Tides and Driftwood Strand Lines Along the East Coast of James Bay. *T. H. Manning* 122

A German Handbook on Alaska. *Review by Robert R. Coats* . . 131

Book Reviews: Das arktische Jahr. Terre stérile. Inuk: au dos de la terre! Apoutsiak: le petit flocon de neige. A German and English glossary of geographical terms. 134

Northern News: Hydrographic expedition to the Beaufort Sea. Some relationships of plant communities to the physical environment in Alaska. Arctic Dog Disease. Uranium prospecting in Alaska. Microfilms of M'Clintock journals. Tuberculosis Survey: James and Hudson bays, 1950. 138

Obituary: Lincoln Ellsworth, 1880-1951. 142

Geographical Names in the Canadian North. 144

Loss of Snow Cornice aircraft carrying Mrs. Walter A. Wood and Miss Valerie Wood

Shortly before going to press news was received that hope for the safety of the occupants of the Institute's Norseman aircraft, missing since July 27, had been abandoned. The aircraft took off from the Snow Cornice Research Station on the Upper Seward Glacier for Yakutat, Alaska, but did not arrive at its destination. It was piloted by Mr. Maurice King and was carrying Mrs. Walter A. Wood and Miss Valerie Wood, wife and daughter of Mr. Walter A. Wood, Director of the Institute's New York Office. An extensive search has been carried out by the U.S.A.F. Air Search Rescue Service, the R.C.A.F., and others, but no trace of the aircraft has been found.

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Photo: Peabody Museum, Harvard University

Kaadaraadar, ivory image of the Aleut deity, found in excavation of Chaluka, Umnak Island, 1948.

A NEW VIEW OF THE HISTORY OF THE ALEUTIANS

W. S. Laughlin and G. H. Marsh

THE unique position of the Aleutian Islands, forming a chain between two major continents, Asia and the New World, has resulted in much discussion on the origin and affinities of the Aleuts. The paucity of sound anthropological data together with the tantalizing proximity of the Komandorskie Ostrova, some 180 miles from the westernmost of the Aleutian Islands and only 90 miles from Kamchatka, have permitted the suggestion that the Aleuts followed this route from Asia to their present home.

The early Russian fur traders, following Bering's discovery of the Aleutians in 1741, found a friendly and knowledgeable population. These people, later named Aleuts, were Mongoloid in appearance and lived in semi-underground houses not unlike those of Kamchatka. To the Russians the Aleuts were no more unlike the Kamchadals than many other Asiatic peoples and without good evidence to the contrary they naturally assumed that the Aleuts were of Kamchadal or other Asiatic origin and that they must have crossed the sea to the western islands from Asia. Bishop Ioann Veniaminov, who lived in Unalaska from 1824 to 1834 and converted many of the Aleuts to the Orthodox Church, encouraged this view by interpreting a local Unalaska Aleut tradition of having arrived from a "big land" in the west to indicate that they came from Asia. European scholars generally accepted this theory.

The first traveller to suggest that the Aleuts came directly from the American continent was Captain P. Zaikov who visited the islands in 1772-8. Again in 1821 Lieut. Otto von Kotzebue remarked, "This people has evidently wandered from the American continent westwards, to the islands" (1821, Vol. 3, p. 313). The American scientist Dr. W. H. Dall gave the first scholarly support to this theory in the latter part of the nineteenth century (1877a), and the Russian-born Professor Waldemar Jochelson, after two years of archaeological and anthropological investigations in the Aleutians and further study on Kamchatka, reaffirmed this view (1925).

Sound interpretation of the prehistory and racial, cultural, and linguistic affinities of the Aleuts has been hindered by a dearth of accurate information. During the past three summers parties of anthropologists, archaeologists and medical workers, sponsored by the Arctic Institute of North America, the Peabody Museum of Harvard University, the U.S. Office of Naval Research, the Viking Fund, now the Wenner-Gren Foundation for Anthropological Research, and the University of Oregon, have collected a large body of new material on these people. This research, which was made possible by the assistance and transportation provided by the U.S. Coast Guard and the three

Nikolski village, Umnak Island, 1950: to the left, Nikolski Bay with Mount Vsevidof in the back
Orthodox

Services, has led to a new interpretation of the history of the Aleutians, of which the general conclusions are presented in this paper.

The field work in physical anthropology was carried out by W. S. Laughlin, University of Oregon, and Stanley M. Garn, Harvard University; in archaeology by Alan G. May, Wenatchee, Washington, Charles I. Shade, Harvard University, Fred Milan, University of Alaska, James W. Leach, University of Oregon, W. S. Laughlin, and G. H. Marsh, Columbia University; in ethnology by W. S. Laughlin, Charles I. Shade, and G. H. Marsh; in linguistics by G. H. Marsh; and in human biology by Fred Alexander, cardiologist, Massachusetts General Hospital, and C. F. A. Moorrees, orthodontist, Forsyth Dental Infirmary, Boston. Work was concentrated on three main areas: the villages of Nikolski, on Umnak Island, and Atka, on Atka Island, and St. Paul Island in the Pribilofs.

Physical Anthropology

The early travellers, using such external features as hair and eye colour, variously linked the Aleuts with the coast-dwelling Siberian Paleo-Asiatics or with the Japanese. The first craniometric study was published in 1859 by K. E. von Baer (pp. 263–7) who measured 6 eastern Aleut skulls and 2 from Atka and noted that the latter were narrower, shorter, and higher in the forehead. In the 1870's Dall collected 27 adult skulls from various islands (1877b, pp. 66–8), but did not draw any precise deductions from his measurements. Next, Mrs. Jochelson, who accompanied her husband, measured the heads of 138 living Aleuts and 50 skulls from several islands. Ignoring sex and geographical distribution Mrs. Jochelson derived a cephalic index of 84.0 (1925, pp. 115–6), which does not correspond to indices for Eskimo from Greenland, northern Alaska, or Siberia; for Paleo-Asiatics—Koryak, Kamchadal, and Yukaghir; or for the Alaskan Indians—Tlingit and Tsimshian. It was Dr. Ales Hrdlicka who first made an anthropometric study of Aleut skeletal remains, following

foreground, the salmon stream leading to the fresh water lake; to the right, the Russian mon trap.

his excavations during the summers of 1936 to 1938 (1945). His most significant finding was the existence of two distinct populations in the Aleutians characterized by quite different headform; this had first been observed by von Baer but ignored by later workers. Hrdlicka noted that the earlier population was oblongheaded and was possibly related to the Sioux Indians, and the later population roundheaded and resembled the brachycranic variety of Siberian Tungus. Unfortunately, Hrdlicka divided the skulls from all the islands into Pre-Aleuts and Aleuts on the basis of morphology, regardless of excavated depth or geographical distribution. As a consequence he was not able to secure a clear picture of when in time, or where in the Aleutian chain, the newer population supplanted the older population, nor of the relative numbers, or extent of the mixture between the two populations.

Our physical anthropological work clearly identifies the Aleuts as part of the Eskimo stock. This thesis is not new and has in fact long been held by Dr. Diamond Jenness, who has classed these people as "Aleutian Eskimo". In common with all other Eskimo-speaking peoples the Aleuts have a large head, large face and lower jaw, tall relative sitting height, medium to submedium stature primarily due to short legs, small hands and feet, and a generally Mongoloid physiognomy particularly noticeable by the epicanthic fold, straight black hair, scanty beard, and narrow nasal root.

The blood groups of the Aleuts also identify them as Eskimo and serve to distinguish them from Indians and from the few Asiatic peoples for whom figures are available. Blood groups are among the most reliable indicators of racial affinities because they are not susceptible to environmental influences as is the morphology, they are inherited independently of sex, they do not change with age, and their exact mode of inheritance is known.

The gene frequencies for the blood groups of the Aleuts as a whole are almost identical with those of Nanortalik, Greenland (Fabricius-Hansen, 1939, quoted in Wiener, p. 299), where European admixture is known to be slight.

The essential characteristic of the blood group distribution among the Eskimo stock is that a larger proportion of the population has blood group A than group O, usually more than 50 per cent, with group B varying from 2 to 12 per cent. European blood increases the percentage of O and decreases the A, at the same time usually raising the B. The western Aleuts, relatively the least mixed, have 50 per cent group A, 45.2 per cent group O, 2.4 per cent group B, and 2.4 per cent group AB. The eastern Aleuts, having had greater contact with Europeans, have 46.3 per cent group A, 44.4 per cent group O, 7.4 per cent group B, and 1.8 per cent group AB (Laughlin, 1950). This same shift in the blood group distributions with admixture has been amply demonstrated in Greenland. Eskimo can be distinguished from North American Indians as the latter are generally completely lacking in group B and have more O than A, though the amount of A is highly variable. Among the Eskimo the group B percentage is appreciably lower than among Asiatic Mongoloids, thus permitting a distinction, but its presence indicates that they have arrived from Asia more recently than the Indians.

The blood types M and N may be used to identify the Aleuts as Eskimo to the exclusion of all Asiatic Mongoloids for whom data are available, but do not distinguish Eskimo from Indians. The Aleuts as a whole have 2.8 per cent type N, but in the 41 western Aleuts typed there was no type N. European peoples and Asiatic Mongoloids, such as the Japanese and Tungus, have around 21 to 25 per cent type N. This large difference provides another reliable clue to admixture. All New World peoples, Indians and Eskimo, have very low amounts of N, and since the Eskimo, who are distinguished from Indians in so many other respects, share this same low frequency of type N, it suggests that a similar low N area may exist among the Paleo-Siberians of northern Asia. The Aleuts, like all other Eskimo and Indians, are 100 per cent Rh positive. The subtypes of Rh may eventually distinguish Eskimo and Indians but at present there are insufficient data.

In order to compare physical measurements of the Aleuts with those of other Eskimo groups it is necessary to adopt a different perspective from that of earlier workers. Professor A. L. Kroeber, using population estimates based on the work of James Mooney for the period of early contact with Caucasians, wrote: "Nearly a third of all the Eskimo lived on open Pacific Ocean frontage —27,300 Aleut, Kaniagmiut, Chugachigmiut, and Ugalakmiut, out of 89,700. From the Malemiut south, that is, roughly, in Alaska from Bering Strait south, were almost 60 per cent of all members of the stock—53,000 out of 89,700" (1939, p. 157). On the basis of our measurements the Aleuts appear to be most similar to the Eskimo of Bristol Bay, for whom there are only a few figures. These latter are for the most part roundheaded Eskimo and have broader and lower vaults than the Central and Greenland Eskimo who have long been used as the "type" for Eskimo. The roundheadedness of the Aleuts (breadth of head 82 per cent or more of the length) does of course distinguish them from Greenland Eskimo, who are more nearly longheaded (breadth of head 77 per cent or less of length), but it does not distinguish them from other western Eskimo. It is therefore most important to recognize a graded series

of headforms for the Eskimo stock, from the relatively longheaded Eskimo of Greenland and Arctic Ocean coasts to the more roundheaded Eskimo of the Bering coast to an extreme of roundheadedness in the eastern Aleutians and the south coast of Alaska. The roundheadedness of these western Eskimo has often been used as a criterion of admixture with Indians. There have however never been large enough numbers of adjacent Indians materially to affect the racial composition of the great populations of western Eskimo. A consideration of all available data indicates the polymorphic condition of the Eskimo, seen most clearly in the headform.

The polymorphic condition of the Eskimo stock in the Aleutians and on Kodiak Island was demonstrated by Hrdlicka. In both these areas a long-

Women of Nikolski village showing facial differences between western and eastern Aleuts. From left to right, Mrs. Pauline Krukoff and Mrs. Eva Chercasen, both eastern Umnakers, and Mrs. Virginia Krukoff, western Attuan.

headed population preceded a comparatively recent influx of roundheads. What Hrdlicka missed, that we have been able to show, is the existence of the descendants of the earlier longheaded population in the western Aleutians. The last remnants of the central and western Aleuts, the people of Atka and Attu islands, are even now relatively longer-headed than the eastern Aleuts of Umnak and Unalaska. The male eastern Aleuts have a cephalic index of 84.62, whereas the male western Aleuts have an index of 82.50, and the divergence between the females is even more marked (Laughlin, 1951). Thus, Hrdlicka's "Pre-Aleuts", whom we have found it more useful to term Paleo-Aleuts, have left their imprint on the contemporary population; while the later "Aleuts", or Neo-Aleuts, never migrated west of the Fox Islands in sufficient numbers to obliterate the physical distinctions between the two populations. The differences between eastern and western Aleuts is not confined to headform. Dr. Moorrees found differences in the fissural patterns and in the number of cusps of the teeth as well as in other dental characters.

It is therefore inaccurate to speak of the Aleuts as a single, homogeneous population. They constitute two major breeding isolates. Earlier observers

noticed the narrower face breadth of the western Aleuts which is now substantiated by our measurements. It appears that the Russian-American Company was aware of these two basic isolates, and the accompanying cultural differences, when it established two administrative districts in 1826—eastern and western—for the chain, and when it transported only groups of eastern Aleuts to the Pribilof Islands and groups of western Aleuts to the Komandorskie Ostrova.

Thus the blood groups and the general morphology both serve to identify the Aleuts as Eskimo, while certain of the measurements distinguish two breeding isolates within the Aleutian area of occupation.

Archaeology

The first excavations in the Aleutians were made by Dall in the early 1870's, and consisted of samplings from various sites on different islands. Dall's work was haphazard and incomplete, but from his material he concluded that the Aleuts had left traces of three stages of culture, represented by a Littoral Period, a Fishing Period, and a Hunting Period (1877b, p. 49). More recently another traditional three-period succession has been suggested (Quimby, 1948, p. 78), but like that of Dall, based on artifacts not scientifically excavated. Jochelson, after eighteen months of careful excavation in several sites on four major islands: Unalaska, Umnak, Atka, and Attu, concluded that there were no changes in culture succession sufficient to warrant division into periods (1925). Hrdlicka's excavations in 1936 to 1938 in various islands of eastern, central, and western parts of the chain are the only other work preceding our own investigations begun in 1948. He unfortunately did not keep accurate records of the artifacts removed, nor of the depths at which they were found, and he consistently separated the cultural remains from the skeletons with which they were associated. Thus, while he first demonstrated the presence of two distinct physical variants, he made no reliable observations on the history of Aleutian culture. The few sites excavated by Jochelson which we have been able to revisit indicate that he excavated primarily in sites of the later period and consequently did not secure enough of the Paleo-Aleut skeletons or artifacts to permit recognition.

Our main archaeological work was concentrated on making a cross section of a very large and old village site adjacent to the present Aleut village of Nikolski, on the southwest end of Umnak Island in the Fox Island group. This was supplemented by a small excavation on Murder Point on Attu Island, to provide us with a point of reference in the extreme western end of the chain, and by small excavations at various other sites. Mr. Afenogin Ermeloff, who had excavated for Jochelson in 1912, aided us in retesting some of Jochelson's sites.

The mound at Chaluka, the old Aleut name for Nikolski, is approximately 700 feet long, 200 feet wide, and 21 feet deep; it is composed of shell detritus, fish, bird, and mammal bones, loose rocks, and minor amounts of earth and volcanic ash. Owing to its size and advantageous site, on a sheltered bay with fresh water lakes behind, with a stream where salmon run and a large reef

rich in shellfish, it promised to be one of the oldest sites in the Aleutians, a promise confirmed by carbon-14 tests. It was here that Hrdlicka had found the Paleo-Aleut skeletons underlying the Neo-Aleut.

Excavation at this site has made two useful contributions to the anthropology of the Aleutians: first, a detailed sequence of the material culture represented in 4,000 artifacts of ivory, bone, and stone, and second, the earliest known date for occupation in the Aleutians, or in any Eskimo site. An age of 3,000 years was determined by Dr. W. F. Libby of the Institute for Nuclear

Mound at Chaluka, the old site of Nikolski, showing excavation, 1950.

Studies, University of Chicago, for samples of burned wood taken from a hearth one metre above the natural floor of the site; the lowest level must therefore be several hundred years older.

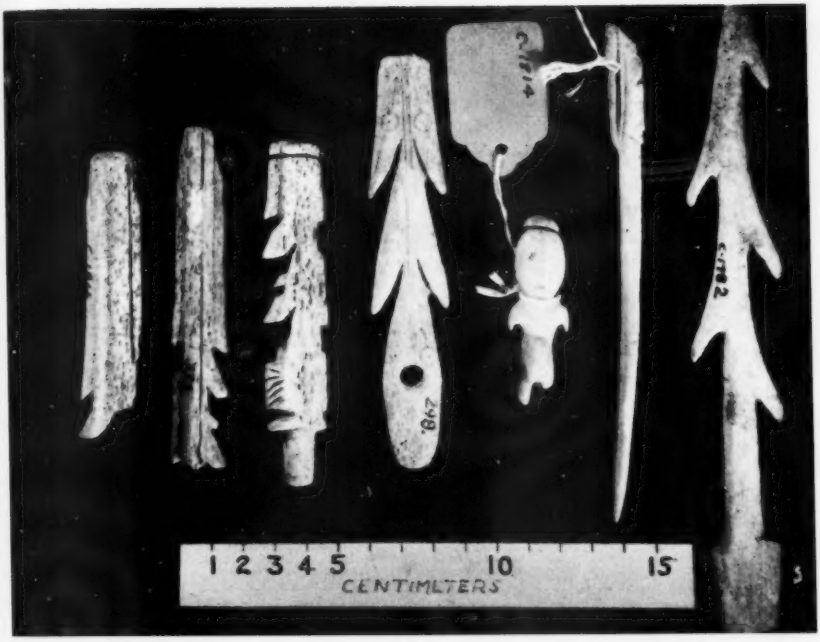
The sequence of artifact types is best seen in the numerous barbed harpoon and spear heads, usually made of whalebone, occasionally of ivory. There appear to be some thirty classes of harpoon heads, each with usually more than one style. Only one of these appears throughout the entire occupation. Though the average duration for each class is one to two metres in depth, with five to ten classes coexistent at any one time, there is no clear break occurring simultaneously between more than one or two classes. Thus it is not possible to divide the prehistory into the traditional three periods. The earliest missile heads are characterized by imbalanced barbs (those on one side being larger and different in design), fluted shafts, rectangular as well as circular line-holes, and compass-drawn circle-and-dot design. The latest weapon heads are elaborately barbed, often symmetrically, with a greater number of barbs, more decoration and possibly ownership marks, and an end basin for insetting stone tips together with the slot insert which was the only method employed in the older harpoon heads. In the surface levels the

socket receiver, a long piece of heavy bone usually made of the jawbone of a whale, with a socket in the forward end for insertion of a bone or ivory point, replaces the older foreshaft-receiver made of two flat halves lashed together. Significantly, the Aleut name for the new type of socket still retains the dual number which referred to the older two-piece socket. This type of socket, used for sea otter hunting in Russian and American times, has not been recovered from our excavation but picked up from the surface of the site or collected as ethnological specimens from the Aleuts who have inherited them from their fathers and can still manufacture them.

Stone lamps, used for heat and light, are found from the lowest levels to the surface, the latest forms being flat, shallow, and more elaborately worked. Two types of larger stone vessels were used, a cooking stove and a cooking bowl; although they occur early no sequence is as yet recognizable for these vessels. No pottery is found and there is no tradition of pottery making among the Nikolski Aleuts. Lamellar flake tools which are very common in the earliest levels disappear later. Other stone tools show few changes until the recent introduction of ground slate knives; ground stone tools are found in the earliest levels. Chipped stone knives with one curved edge, similar to those of the Dorset culture, are found in all levels in quite large numbers. Two ivory household images of the deity were found, one in the lower levels and one in the recent levels. The modern people, though Christians for over a hundred years, retain memory of the name and its use (which they now consider to be the work of the devil). The image was hung inside the house from a string kept in place by a groove in its head, and the head of the household prayed to it, especially before going to sea. Among the recent artifacts are ivory earspools adorned with concentric circles drawn by compass.

The artifacts brought back from the mummy caves on Kagamil Island correspond in date to the superficial layer at Chaluka, represented in such things as ground slate knives, shallow flat stone lamps, and single-piece socket receivers. This recent date ties in with the Russian glass beads and canvas, and the bone lesions suggesting syphilis, also found in the caves. Thus, mummification of the dead of certain outstanding families cannot have long preceded the advent of the Russians. Actual names of some of the mummified Aleuts from Kagamil Island are still known to the Nikolski people.[1] This custom, undoubtedly introduced by the Neo-Aleuts, never reached the people of Attu and Agattu islands at the western end of the chain. The Attuans still report that they considered it a wicked practice.

In summary, the new archaeological picture shows an Eskimo people pushing out into the Aleutians from the mainland over 4,000 years ago, with an open-sea culture, possessed of such typical Eskimo artifacts as stone lamps, labrets, eyed needles, chipped stone side-blade knives, a variety of barbed harpoon heads including toggle heads, and bolas. The styles of some of these utensils change intermittently throughout the period of occupation. The skeletons manifest a people of Eskimo morphology and indicate the arrival in the last third or quarter of the period of a new Eskimo population having a somewhat different morphology. The artifacts fail to show a sudden change



Paleo-Aleut artifacts from various levels. Left, three harpoon-head fragments with routed shanks, imbalanced barbs, and slotted tips for stone point insert; centre, one harpoon head with large compass-drawn circle-and-dot decoration; right, a household image of the deity in sperm whale tooth ivory, an ivory bodkin with carved faces on butt, and early style harpoon head with alternating barbs.

Neo-Aleut harpoon and spear heads. Top, bone foreshaft and ivory point of modern sea otter harpoon (given by present inhabitants); middle, fish spear excavated complete with stone point (similar to Ipiutak); bottom, multi-barbed foreshaft for war spear with spoon-depression in tip for stone point insert.

with the new arrivals, from which one may judge that the two populations had similar cultures and that whatever innovations the new people brought filtered west more rapidly than the population itself. Thus, though there are no sharply marked periods in Aleut prehistory, there are two periods in the sequence of population in the eastern sector of the Aleutian Islands, which are less noticeable in the western Aleutians.

Ethnology

The first useful ethnological information comes from the writings of Bishop Veniaminov, who learned the language and attempted to preserve knowledge of the pre-Russian beliefs and customs (1840). The only strictly ethnological investigation antedating our own is that of Jochelson (1925, 1933). Here we will present only those things not previously discussed by Jochelson or Veniaminov. Fortunately, the Aleuts have sufficiently conserved their language and many other customs, as well as the memory of many more now abandoned, for it to be possible to compile an adequate picture of their pre-contact life with some of the east to west differences.

In common with other members of the Eskimo stock mechanical innovations have played a major part in the remarkably successful adaptation of the Aleuts to their environment. In their case this has often been the result of deliberate comparative experiments. Their culture is directed toward the development of self-sufficient individuals within the framework of a highly co-operative group. The system of a First, Second, and Third Chief which has been cited as evidence of social stratification comparable with that found among the North Pacific Coast Indians, was introduced by the Russians for more effective control of the villages. In the pre-Russian organization the village was under the leadership of a headman whose principal function was to coordinate all the cooperative efforts of the village, including warfare. He achieved his position by virtue of superior strength and wisdom, and was dispossessed if found wanting in either attribute. He was known as *tuku* "the wealthy one" or *agnaka* "the master" or "owner". The many accounts of Aleut headmen are most similar to those of the headmen or "strongmen" among the Maritime Chukchi. The position of headman was neither inherited nor possessed of special rewards other than the personal satisfaction of dominating the village and leading the men in exploits of valour. His training was that of a "strongman", a rigorous training given to all who were going to be hunters.

The belief in the potential danger of power is seen most clearly in the customs of joint binding and dismemberment. Till quite recently a young woman at menarche was isolated for forty days, and confined to a dark room, formerly a separate hut. It was recognized that she was possessed of great curative powers, and men were brought to her to be treated for a variety of pains, illnesses, and significantly, seasickness. She was attended by her mother or other female who had been through the same ceremony. At the beginning of confinement each of her joints—wrist, elbow, shoulder, ankle, knee, waist, neck—and head were bound with a waxed cord. Failure to bind the joints would bring premature senility and joint disease to the woman, and harm to the village's food and water supply. For five months after confinement she

could not go upon the sea. The belt she wore about her waist retained curative powers and was preserved for future treatments. Previously overlooked was the fact that a widowed man or woman undergoes the same isolation and joint binding. The belt of the widow is even more powerful than that of the pubescent girl.

Dismemberment is also related to the same theme of control of supernatural power in the body as is joint binding. The killer of an enemy dismembered him to ward off certain dangers, principally joint disease. Throughout the old tales dismemberment of a demon slain by a famous "strongman" occurs with great regularity, often augmented by burning and burying. Within the memory of persons now living in Nikolski, an Aleut man was dismembered in order to protect his killer. Common to these practices is the belief that great power resides in even the dead body and is not dissipated by death. Thus the most potent charm used by the Aleuts was a "piece of dead man" (taken from a mummy) carried as an amulet, which endowed its owner with all powers, but brought him early death or blindness. Mummification or preservation of the body intact with its powers was the opposite of dismemberment. Thus, recognition of the cultural theme of a belief in supernatural power resident in the body explains those patterns connected with its control and its use: joint binding, dismemberment, and the use of mummies.

A most fascinating cultural achievement of the Aleuts was the development of an incredibly thorough knowledge of human anatomy, much of which still survives. A note in the writings of Veniaminov prompted us to investigate this neglected aspect of Aleut ethnology, "The Aleutians have a very extensive anatomical vocabulary. Reference is not made to words like liver, heart, intestines and the like but to several terms, the use of which presupposes familiarity with the details of the structure of the body. . . . Entire ignorance of anatomical terms makes it impossible for me to translate all of them" (foreword in Geoghegan, 1944, p. 19). We not only collected their anatomical terms and system of classification, but checked them by asking the Aleuts to name the parts of dissected seals and excavated human skeletons. The detailed knowledge of the Aleuts may be indicated, for example, by their classification of muscles. The word *kayu* indicates a muscle as a motor organ and a source of strength and is applied primarily to the biceps humeri and the quadriceps femoris. The term *sayuti* refers mainly to a flat muscle and possibly indicates the muscle as a structure of the flesh. A long, stringy muscle is called *igaci* "something fastened at the end", which is the same name for tendon or sinew. Names are also given to the particular muscles in each class, for example the M. brachioradialis, an outside muscle of the forearm, is named *cam angalii* "the daylight of the hand" because a sharp rap across it will incapacitate the hand and lower arm, a fact used by the Aleuts in wrestling and fighting. The Aleuts give the dual ending to the entire jaw of animals and humans, and the singular ending to each half, recognizing that in humans the two halves become fused at the mandibular symphysis.

Investigation of the sources of their knowledge revealed the existence of true comparative anatomy and dissection of the dead. Aleut doctors

dissected the sea otter because it was most similar to human beings in morphology and, in fact, is the only sea mammal to preserve a pronating and supinating forearm, to have flat, grinding molars, and several other similarities. A former resident of Nikolski is considered to be the last of the Aleuts to participate in the dissection of a human, being a woman she watched while the men carried out the autopsy. Other sources of information were provided by the extensive use of animal parts (for example, the pericardium for a water bag), also health and medical practices, and the preparation of mummies.

The beliefs surrounding the manufacture and use of the kayaks and umiaks illustrate not only the Eskimo cultural heritage of the Aleuts, but also their specialized interest in anatomy and the power which resides in the body.

Linguistics

Since 1819 when the Danish linguist Rasmus Rask wrote down some two hundred words spoken by two Aleut brothers brought to St. Petersburg and pronounced Aleut an Eskimo language, those dealing with this language, namely Veniaminov, Dall, Thalbitzer, and Jochelson, have held the same view.

Гꙋспꙋдакъ!игинъ Тхинъ	Господи, помилуй насъ.
нтꙋгнисада. г̄ днмъ.	Трижды.
Тꙋманинъ ѧдакъ п)!	Отче нашъ, Иже еси
ѧманъ акꙋхтхинъ н-	на небесѣхъ! да святится

The opening phrases of the Lord's Prayer in Aleut left, and Russian right, from p. 9 of 'Aleutskiy Bukvar' ('Aleut Primer') by I. Veniaminov, the first printed Aleut book.

In fact this contention of the linguists has been one of the chief reasons for the thesis that the Aleuts are Eskimo, which caused Hrdlicka to fulminate while trying to prove that racially they were not: "It is only the professional linguists who class the Aleuts as Eskimo, even though there are many known examples of peoples who through circumstances have changed their language . . ." (1945, pp. 543–4). These professional linguists never proved their case because they knew Aleut too poorly and worked chiefly with superficial comparisons. However, we can now show that the fundamental structure and some of the basic vocabulary corresponds in the two languages. The percentage of basic vocabulary correspondence in Aleut and Eskimo indicates that these two branches of the common language, proto Aleut-Eskimo, separated some 4,000 years ago (Marsh and Swadesh, 1951). The Aleuts have been greatly aided in retaining their language by the existence of the Aleut alphabet specially adapted for their use from the old Cyrillic alphabet by Veniaminov ('The life and work of Innocent', 1897, p. 10).

Although Aleut is not mutually intelligible with Eskimo its three dialects are all mutually intelligible among themselves. Confirmatory evidence of the westward drive of the Aleuts is seen in the dialect distribution. Veniaminov notes that around 1830 the Aleuts of Umnak Island spoke the Atka dialect.

Today, they speak the Fox Island dialect, but place names at the northern end of the island are still in the Atka dialect.

We thus find that the linguistic evidence further corroborates the proof from our recent physical, archaeological, and ethnological research that the Aleuts and Eskimo are members of the same stock. Likewise the linguistic chronology confirms the period of separation of the Aleuts from proto Aleut-Eskimo, which is independently indicated by the archaeological evidence.

Conclusion

In retrospect we see in the Aleuts a population of the same stock as the Eskimo with the oldest dated prehistory and longest continual residence in the area of their occupation. Their history is that of two successive Mongoloid peoples pushing out into the Aleutian Islands from the Alaskan mainland, bringing with them all the traits and implements of an extensive open-sea economy. The first wave of migration must have started over 4,000 years ago, while the second was well within the last 1,000 years and was continuing at the time of Russian discovery. Some of the physical traits of the first population persist among the remnants of the central and western Aleuts. The physical traits of the second people dominate most completely the eastern third of the chain. Judging from our Nikolski finds, the culture of this entire span of occupation was continuous in sequence. Changes in the styles of weapons occurred frequently. Other implements present but few and slight variations, until the very recent introduction of ground slate knives and ground shallow lamps.

The great numbers of the Aleuts and other Eskimo in southwestern Alaska may have arisen through a "population explosion". The ecological picture is clearly that of an area rich in those natural resources that could support many more people than any region to the north. When the first proto-Eskimo came south along the west coast of Alaska and found an area incredibly abundant in sea mammals, fish, fowl, and wood (driftwood), they were able to expand their numbers relatively rapidly. With a proportionately larger population than any of the neighbouring peoples they were in a position to diffuse traits of the culture that they elaborated here to adjacent areas. Recognizing the Alaskan south coast, Kodiak Island, the eastern Aleutians, and the west coast to the Kuskokwim River as a climax for the western Eskimo may be useful in explaining traits from this area among Indians to the south and among other, and later, Eskimo.

A conservative estimate of the pre-Russian Aleut population places their number at 16,000 (Kroeber, 1939, p. 157), an estimate well supported by the quantity and size of old village sites. Thus, the twenty-two village sites of Umnak Island probably had a total population of over 2,000; Amchitka Island has forty recorded village sites, and modern Attuans tell of a tradition of 3,000 inhabitants in the Near Islands. Of that vast Aleut population but some 1,200 remain, over half of whom reside outside their aboriginal homeland, in the Pribilof Islands and in the Komandorskie Ostrova. Since the appearance of the Europeans the basis of the economy has been seriously affected through the

slaughter of sea mammals, reduction in numbers of fish, and grazing off of the vegetation. In addition, diseases, together with the early massacres, reduced the population. The decline of the Aleut population is unfortunately continuing. Nikolski village at the turn of the century had some 125 inhabitants, in 1938 only 85, and in 1950 but 59. Introduction of refined foods has resulted in much dental deterioration, most marked when the teeth of the present inhabitants are compared with the teeth of the skeletons, but also seen in the poorer teeth of the younger people as compared with the older living Aleuts. Dr. Alexander (1949) found tuberculosis, venereal diseases, scabies, refractive errors of the eyes, and trachoma the most prevalent diseases, but an interesting absence of hypertension. With proper attention, medical and social, the Aleuts could be made vigorous and enabled to make more extensive use of the vast economic resources of the Aleutian Islands which were so successfully exploited by their ancestors.

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EOLIAN DEPOSITS OF ALASKA

Robert F. Black*

EOLIAN deposits of Pleistocene to Recent age are recognized in all major regions of Alaska (see Fig. 1). Lack of economic incentive and of suitable base maps or air photographs have in the past precluded much detailed work on such deposits. Further, complexities produced by growth of vegetation, reworking by streams, and, particularly in areas of permafrost, by frost action and mass wasting processes, tend to mask, assimilate, modify, or remove eolian materials as they accumulate. Consequently at present only a small proportion of the eolian deposits can be shown on a map and relatively few data are available on their morphology, stratigraphy, and genesis. This paper is an attempt to summarize these data, at the request of the U.S. National Research Council Committee for Study of Eolian Deposits in North America.

The writer has visited all the major areas of eolian deposits described here and has incorporated into the text and map his own ideas or interpretations rather than utilizing only those of other workers. He acknowledges gratefully the unpublished information and comments received from each of the persons listed on Fig. 2, who have carried out detailed studies of the areas shown. Many ideas expressed, for which individual acknowledgment is difficult, originated with them. Special mention should be made of the valuable summaries by Clyde Wahrhaftig and David M. Hopkins, parts of which are quoted verbatim. David M. Hopkins, W. A. Rockie, and Troy L. Péwé, in particular, critically reviewed the entire manuscript.

For convenience, the eolian deposits are discussed in three major groups, in each of which the physical setting and types of deposits and their genesis are similar. These groups are: Coastal plain of northern Alaska; Areas associated with glacial streams; and Coastal margins. These groups grade into one another and, obviously in a region as large and as complex as Alaska, many variations exist from one deposit to another. The areas associated with glacial streams have been subdivided because of their diversity, enormous area involved, and lack of information.

The writer believes that only higher parts of mountain ranges and local areas in the lowlands, together comprising less than half the territory, have escaped some eolian deposition. However, eolian materials over a wide area either were very thin and have been removed, or else have been masked or assimilated by other sediments. In southeastern Alaska eolian deposition is confined to the neighbourhood of braided glacial streams.

Fig. 1 shows only those areas in which eolian materials are known to occur; in many districts the extent of the eolian materials is believed to be greater than that shown.

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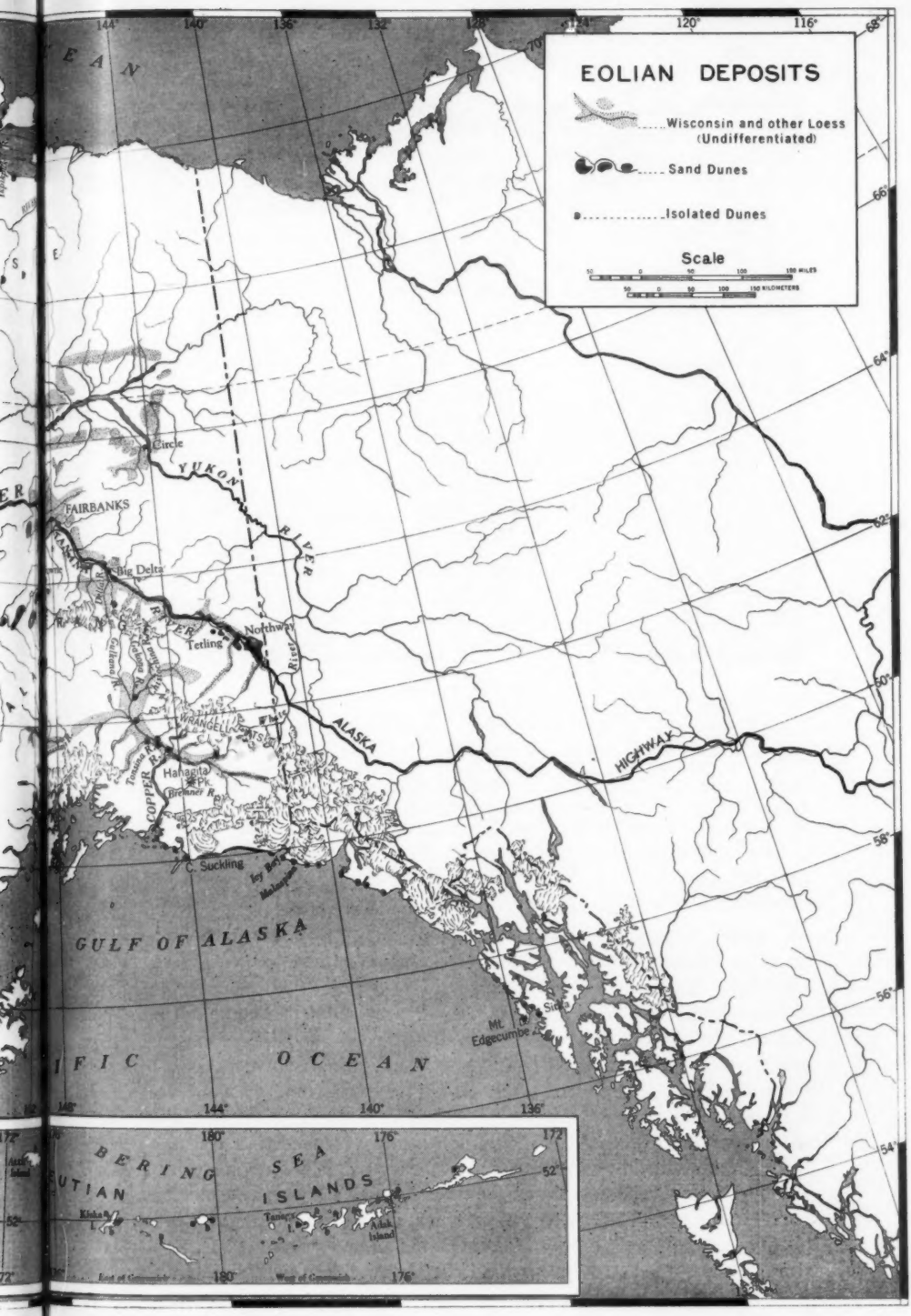
Fig. 1. Eolian deposits of Ala nation



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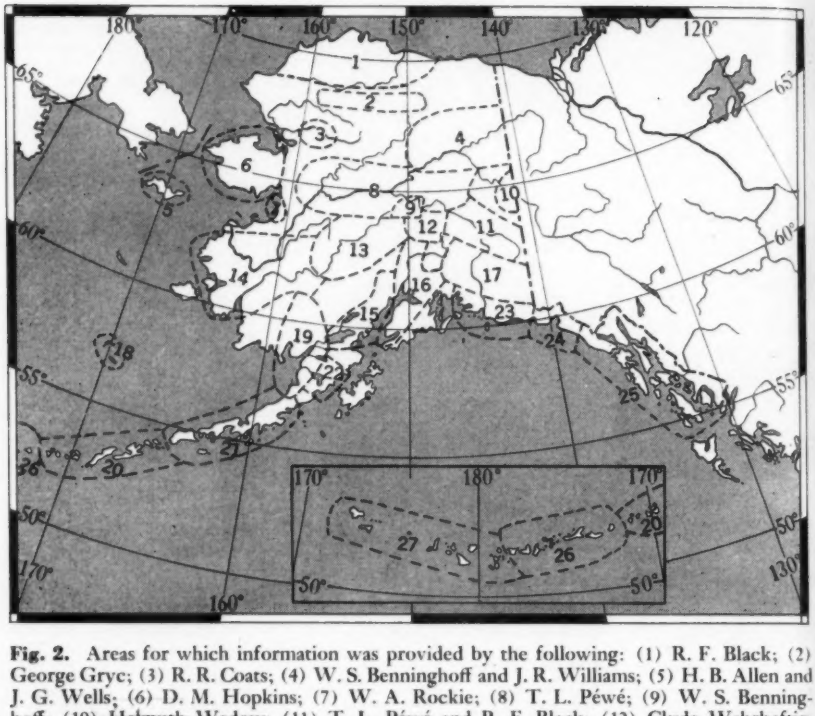

Fig. 2. Areas for which information was provided by the following: (1) R. F. Black; (2) George Gryc; (3) R. R. Coats; (4) W. S. Benninghoff and J. R. Williams; (5) H. B. Allen and J. G. Wells; (6) D. M. Hopkins; (7) W. A. Rockie; (8) T. L. Péwé; (9) W. S. Benninghoff; (10) Helmuth Wedow; (11) T. L. Péwé and R. F. Black; (12) Clyde Wahrhaftig; (13) A. T. Fernald; (14) J. M. Hoare; (15) R. F. Black; (16) T. N. V. Karlstrom, W. A. Rockie, and I. J. Nygard; (17) F. H. Moffit, R. F. Black, and I. J. Nygard; (18) F. M. Byers from notes of T. F. W. Barth and Ray Arnett; (19) E. H. Muller; (20) F. M. Byers and R. E. Wilcox; (21) H. H. Waldron; (22) and (23) D. J. Miller; (24) R. F. Black; (25) W. S. Twenhofel; (26) R. R. Coats; (27) H. A. Powers, R. R. Coats, F. M. Byers, R. E. Wilcox, and Olcott Gates.

Coastal Plain of Northern Alaska

Eolian materials can probably be found at least locally over most of northern Alaska. Stabilized longitudinal, parabolic, and multicyclic dunes, hitherto undescribed, occur over an area of about 5,000 square miles on the coastal plain west of the Colville River (see Fig. 1). Discontinuous and isolated dunes are active along most of the rivers and larger streams, along part of the coast northward from Cape Beaufort, and on the higher banks of many of the larger oriented lakes. Loess, a few inches to several feet thick, is recognized along the west bank of the lower Colville River and is probably ubiquitous in northern Alaska, although it is covered in most places by vegetation and modified by frost action, mass wasting processes, and stream erosion.

The following data and tentative conclusions are based on incidental field observations in 1946-7 by the writer and on interpretation of a small proportion only of the air photographs of northern Alaska. The coastal plain, although not glaciated, is particularly favourable for eolian erosion and

deposition because of high winds, lack of topographic obstacles or wind breaks, low precipitation, and abundance of silt and sand that cover the plain to a depth of several tens of feet. But for permafrost, which impedes surface runoff and permits luxuriant vegetation to grow in spite of low precipitation, the coastal plain would be a desert with rapidly shifting sands. "When the wind blows, which seems to be most of the time, a veritable sheet of sand is sent scudding along the beaches above the high-tide level with stinging velocity until the grains lodge in the lee of some obstruction, such as a log or even a piece of shell" Smith and Mertie (1930, p. 249). The U.S. Weather Bureau records east-northeast as the dominant wind direction at Barrow and west-southwest as the secondary maximum. Numerous oriented lakes and dunes (Black and Barksdale, 1949) throughout the coastal plain show that these maximum winds are just as consistent and effective inland and that slightly more erosion is produced by the easterly (65° to 80°) than by the westerly winds (245° to 260°), though local topography may be even more important in determining the position and shape of dunes. High-velocity winds from the northern and southern quadrants are also fairly common and modify the effects of the easterly and westerly winds.

In the large area of stabilized dunes on the coastal plain west of the Colville River, longitudinal and parabolic types are the most abundant, and several varieties of these two types are recognized (see Fig. 3). Many can probably be described as lee-source, windrift, and elongate-blowout dunes; transverse dunes and undifferentiated types are represented; multicyclic dunes are probably present. The area delineated on Fig. 1 shows the approximate distribution of the stabilized dunes. The adjacent individual '*D*'s' mark active blowout areas. Surface materials favourable for the formation of dunes extend westward to the Arctic Ocean between Wainwright and Point Lay. That area is higher, more rolling, and more dissected, and old stabilized dunes, if once present, have been so modified as to be unrecognizable on the available air photographs. None were seen on air reconnaissance during permafrost studies, but from ground studies Karl Stefansson and Marvin Mangus, of the U.S. Geological Survey, report stabilized dunes along the Kuk River. Surface materials east of the Colville River are coarser and are not nearly as favourable for the formation of dunes (Leffingwell, 1919, p. 175).

The stabilized dunes are scattered abundantly in the areas interjacent to lakes and streams (Black and Barksdale, 1949, pl. 3B); they are absent on the river floodplains, on the beds of most, though not all, drained lakes, and on the steeper slopes where soil movements are very rapid. The dunes are most abundant on tops of ridges or other topographic irregularities and are associated commonly with cut banks of large lakes and streams.

The dunes vary considerably in size from place to place although no regional variation was noted. Most longitudinal dunes are less than 3,000 feet long, but the longest is about 8,000 feet. Most appear to be only a few feet thick, although some may be as much as 10 to 20 feet. If they were ever high, geomorphic processes have reduced them. They commonly merge into the tundra and are generally marked by a change in vegetation only,

Photo: U.S. Navy

Fig. 3. Stabilized dunes on the coastal plain of northern Alaska, 70°32N., 153°14W., 5 August 1948.

caused by the slightly greater thickness of the active layer (zone of seasonal freezing and thawing) and better drainage. The parabolic dunes commonly merge into the longitudinal dunes to form complex types and presumably were formed simultaneously. The winds that produced most of the dunes blew from the same direction as the predominant winds of today. Shifting of the winds from easterly to westerly and less commonly to northerly or southerly directions has produced complex varieties of the longitudinal and parabolic types and superimposed one on another to form transverse and complex dunes. Other earlier orientations are believed to exist but none were determined conclusively in the field or from air photographs.

The majority of the stabilized dunes are being destroyed by migrating lakes and streams, by frost heaving, growth of ice-wedge polygons, and other

Photo: U.S. Navy

Fig. 4. Active blowouts and stabilized dunes on the coastal plain of northern Alaska, 69°51N., 152°52W., 13 August 1948.

weathering and erosional processes. However, many are still being supplied with additional material from blowouts along lake and river banks. The largest blowouts seen on air photographs are more than a million square feet in area; though most are only a few thousand square feet (see Fig. 4). From air photographs it would seem that the vegetated dunes in these active areas are only slightly higher and more clearly defined than other dunes that are not being supplied with sand. Small active blowouts may appear on the stabilized dunes and produce further complexities.

As the dunes are derived largely from local materials, the sands vary considerably in composition. Near the Colville River the dunes are formed from the Gubik sand, described by Schrader (1904, p. 93). Through the central Ikpikpuk River and Meade River areas the materials are principally

medium-grained white to yellow and tan quartz-rich sands (see Fig. 5).

The age of the majority of the dunes is not known. Some are forming slowly today; others are completely inactive and are considerably modified by geomorphic processes. Some seem to be older than the ice-wedge polygons with which they are associated, and some are definitely younger. It is believed that the majority of the dunes were formed in a climate slightly warmer than that of today. The active layer would have been thicker and would therefore

Fig. 5. Blowout dune partly stabilized by vegetation on bank of lake, 70°28N., 157°55W., in northern Alaska, 25 August 1947.

have permitted better soil drainage. Vegetation would probably have been slightly sparser, though some must have been present. Surface soils would have dried out more than they do now. Such a climate could probably have been produced in the post-Pleistocene optimum. What effect the northerly (or southerly) winds, postulated for the origin of the oriented lakes, had on the formation of these or earlier dunes cannot be surmised at this time.

Tops of many polygonal mounds along coastal banks, inland along lake and river banks, and on the open tundra, are frequently stripped by winds. During a period of a few weeks in summer, vegetation and a few inches of clay, silt, and fine sand may be removed. This very slow eolian reworking of the uppermost soil layers in the drier places is continuing each summer and is aided by the exposure of additional material by frost action (see Fig. 6).

Along the braided rivers, such as the lower Colville, Ikpikpuk, Topagoruk, and Meade, the exposed bars are constantly subject to wind action. As pointed out by Smith and Mertie (1930, p. 249), sand and silt are swept up from the bars and piled up 10 to 20 feet high on the river banks. The coarser material is deposited quickly; the silt is probably carried for miles. The soil in many

places along the west bluff of the lower Colville River is formed from silt a few inches to several feet thick; one exposure visited contained more than 10 feet of this silt, much of which seemed to be loess.

Even small willow shrubs may impede winds sufficiently to cause a few inches of silt to be deposited around them. Most of the loess is incorporated into the marshy, tundra soil by the growth of vegetation and by frost processes and is not recognizable. It stands out markedly, however, on the drier ridges

Fig. 6. Frost-stirred and wind-eroded top of silt polygon, Barrow, 7 August 1946.

and banks. It probably is being formed today adjacent to most rivers and lakes with high banks and exposed tundra polygons. The process may well have been more widespread in the past.

Areas Associated with Glacial Streams

Eolian deposits, locally reworked by streams, lakes, and tides, are found in all glacial outwash plains and most glacial stream valleys in Alaska. The dust storms associated with the braided streams of today are familiar to all travellers in Alaska. At present, glaciers cover less than 4 per cent of Alaska (Smith, 1939, p. 67), but possibly a quarter of the territory has been glaciated in the past, and no part of Alaska is more than 225 miles and much is less than 150 miles from a glaciated area. Most major streams traversing the non-glaciated areas have been fed by glacial waters at some time and carry or carried abundant material of silt size. Undoubtedly, former winds, commonly blowing outward from the major mountains, picked up sand and silt from the exposed bars and banks of those streams and redeposited them elsewhere as the winds are doing today. Because of topography, dense vegetation, high rainfall, and

Photo: U.S. Navy

Fig. 7. Stereographic vertical air photograph of compound dunes near the junction of the Alaska Highway and the 40 Mile Road, upper Tanana valley, 13 September 1948.

scarcity of materials, large areas in southeastern Alaska, although glaciated, are far enough from braided streams to be free from eolian materials.

Throughout non-glaciated areas in central Alaska, creek bottoms and even the flanks and tops of low hills may be buried under silt deposits as much as several tens of feet thick on the summits and as much as hundreds of feet thick in the valleys. Over broad areas the silts are similar, though local variations may be pronounced. In particular the silts on the uplands are clean, non-stratified, and largely yellow to light brown. The silts in the valleys are commonly stratified, rich in organic matter, and brown, grey, or black. Local conditions probably varied greatly from valley to valley during glacial times when most of the deposits seem to have been formed.

There is considerable divergence of opinion today on the origin of these tremendous quantities of silt and no attempt can be made here to discuss the problem in detail. Relatively little is known of the distribution of the various silt formations and their character. Taber (1943, pp. 1471-3) has written: "The Alaska silts have been formed and deposited in several different ways, and some have had a very complex origin. They contain material produced by glaciation, volcanic activity, organic processes, and weathering, and the deposits may be classified as residual, aeolian, fluviatile, lacustrine, and marine."

Numerous areas of sand dunes also are associated with the glacial valleys. Only a few of these and some known areas of loess are shown on Fig. 1. It is the writer's opinion that many of the extensive silt blankets known to occur throughout central Alaska will prove to be eolian in origin but modified through frost action and growth of vegetation.

Central Yukon River and lower Tanana River

In central Alaska, in the drainage of the Yukon and Tanana rivers, the origin of the silts and so-called mucks has long been controversial (see for example Eakin, 1916, pp. 55–61, 67, and 69–75; 1918, pp. 35–6 and 43–8; Mertie, 1937, pp. 186–9; Eardley, 1938; Giddings, 1938; Capps, 1940, pp. 164–5; Tuck, 1940, pp. 1295–310; and Taber, 1943, pp. 1471–503). Formerly a lacustrine origin was proposed for much of the silt except that in stream floodplains. Later workers accepted an eolian origin for much of it, except Taber (1943, p. 1473) who advanced . . . "the hypothesis that the creek-valley silts have been formed chiefly by disintegration of local country rock, the products of weathering having been moved down the valley slopes by soil creep and slope wash and distributed over the valley floors by occasional floods." The writer, like Troy L. Péwé (oral communication) and Tuck (1940), favours an eolian origin for much of the original silt, recognizing that considerable movement has taken place from the hillsides to the creek bottoms as quoted from Taber, and that locally frost action has supplied large quantities of material that have been partly mixed with the loess. The thick "muck" deposits cannot be regarded as primary loess deposits. The thickness varies so greatly that no general figures are given, though it may reach as much as 80 feet, for instance, on low hills near Fairbanks. The silts vary considerably in composition and structure and somewhat in size-grade distribution. A great amount of work

Fig. 7. Stereographic vertical air photograph of compound dunes near the junction of the Alaska Highway and the 40 Mile Road, upper Tanana valley, 13 September 1948.

needs to be done to delimit the horizontal and vertical extent of the loess and to distinguish silts of eolian origin that are also found in central Alaska.

A few stabilized longitudinal and other dunes have been noted by Moffit (1942, pp. 112-3 and 138) and Troy L. Péwé. Those near Big Delta are from 5 to 10 feet high, 100 to 300 feet long, and possibly 50 feet wide.

Upper Yukon River

Silts of possible eolian origin have been recognized along the upper Yukon River by Eakin (1916, pp. 55–61) and Mertie (1933, pp. 434–9; and 1937, pp. 188–9). Their extent is not known. In 1948–9 William S. Benninghoff and John R. Williams found that the superficial soils near the present floodplain of the Yukon River, between Stevens and Circle, are mainly composed of silt. Most of this is alluvial, though winds are constantly reworking it on the exposed bars and dust clouds are common. On a terrace 180 feet high bordering the southern margin, fine tan silts up to several tens of feet in thickness may be eolian. The northern rim of the valley is covered by 1 foot to 2 feet of reddish brown silt, locally mixed with float gravel and fine sand, which is tentatively mapped as eolian.

Upper Tanana River

During glacial times the upper Tanana River, in the Tetling-Northway flats, was occupied by a large lake, which left behind isolated sand and silt terraces as much as 350 feet high (Van Alstine and Black, 1944; and Wallace, 1948, p. 172). The upper surfaces of these terraces have been modified by wind into well-developed longitudinal, parabolic, compound, and undifferentiated dunes, 200 feet high (see Fig. 7). In places along the edge of the valley the dunes encroach on the bedrock hills. Most have been stabilized with vegetation for at least 1,400 years as they are covered by 4 to 8 inches of volcanic ash, believed to be of that age (Capps, 1916, p. 83). The dunes are perennially frozen, commonly as "dry-permafrost" (Wallace, 1946, pp. 16–7). In the vicinity of Northway approximately 85 per cent of the material is tan to black sand, the remainder is silt.

The major dune-forming winds blew from the northwest, but southwest winds have had some effect. These dunes, about which little is known, are among the best developed in Alaska and warrant detailed study because of their large size and peculiar shapes.

Loess a few inches to a few feet thick is essentially continuous along the glacial streams and may extend for considerable distances northward into the Yukon–Tanana Plateau, where centres of local glaciation and thick "muck" deposits are known.

Kuskokwim and Kantishna rivers

The Kuskokwim and Kantishna valleys were not glaciated, but they were traversed during glacial times by many glacial streams. These drained the Alaska Range to the east and south and also many centres of local glaciation to the north and west respectively. Broad outwash fans from the piedmont

and valley glaciers (Capps, 1935, p. 76) filled the valleys to depths of possibly several hundred feet, as in the Yukon and Tanana valleys, and were favourable areas for wind action. Because of somewhat different source materials, of higher gradients, and proximity of glaciers, the central and upper Kuskokwim and Kantishna valleys contain more sandy surface material and therefore more sand dunes (see Fig. 1) than the central Yukon and lower Tanana valleys.

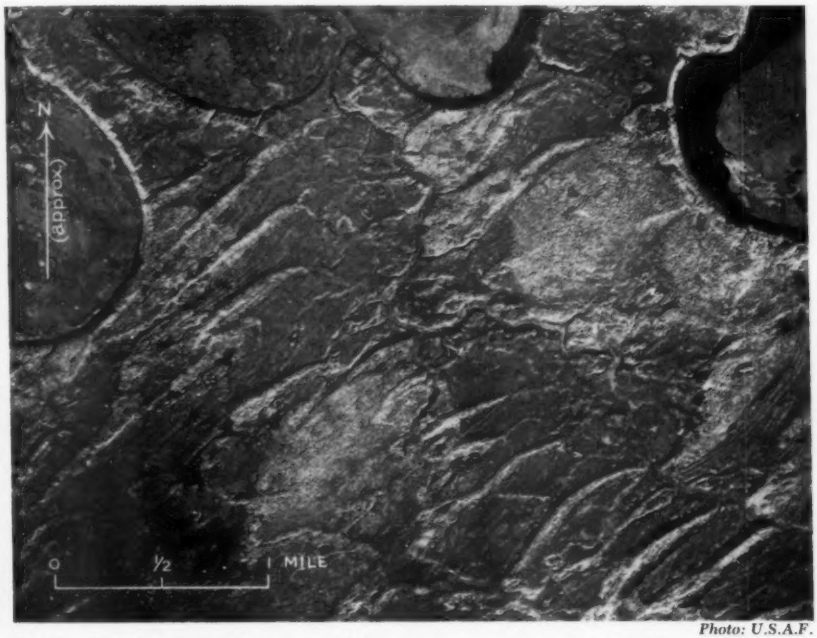

Photo: U.S.A.F.

Fig. 8. Parabolic dune ridges and undifferentiated dunes on a dissected alluvial plain about seven miles east-southeast of McGrath.

Arthur T. Fernald and William H. Drury record (in a letter) that near McGrath parabolic dunes of fine- to medium-grained sand average 25 feet in height and 2,500 feet or more in length (see Fig. 8). In the upper Kuskokwim and Kantishna valleys parabolic, longitudinal(?), and undifferentiated dunes are possibly 10 to 50 feet high and many are more than a mile long. Throughout the valleys compound and undifferentiated types may be found. All are stabilized by vegetation, but rarely small active blowouts may be seen.

Loess deposits 15 to 60 feet thick are recognized at two places (see Fig. 1) and are undoubtedly much more widespread. Extensive silt formations are known in the lower Kuskokwim and may prove to be eolian but are not shown on Fig. 1 because their origin and distribution are not known (Mertie and Harrington, 1924, pp. 44–9). Small active blowouts in silt and fine sand are common in the Kuskokwim delta.

Copper River

During glacial times the Copper River basin was buried under several thousand feet of ice that left behind hundreds of feet of unconsolidated sediments (Moffit, 1938, p. 113). These are being dissected by streams and have been exposed to wind action for centuries.

In 1901 Schrader and Spencer (p. 61) wrote of the Copper River region: "Besides wind-blown deposits in the forms of dunes, the surface soil is frequently composed of fine sand, doubtless of similar origin, and careful investigation would probably show that eolian deposits are rather generally distributed over the Copper Basin." This statement was supported by Tarr and Martin (1913, p. 295–300) and by Moffit (1914, pp. 31–2; 1918, p. 46; 1938, p. 100; and 1941, p. 144) and it seems that a considerable proportion of the present soil adjacent to the major glacial streams in the Copper River region is wind-blown silt from the bare floodplains. The limits of these materials have yet to be determined. Probably they encroach on the foothills of the Wrangell Mountains, and extend farther down the Copper River into much of the Hanagita Peak and Bremner River areas (Moffit, 1914, p. 31–2) and northward up the Chistochina, Gakona, and Gulkana rivers. However, the glacial streams flowing south from the Alaska Range seem to be less important as producers of loess than the streams flowing north.

The wind-blown silts vary from grey, yellow, buff, tan through brown. The fineness of the particles increases with distance from the streams. These silts are described in some detail by Tarr and Martin (1913, pp. 295–300; see also Bennett and Rice, 1919, pp. 227–8).

Sand and silt dunes are outstandingly developed along the banks of the Tonsina and Chetaslina rivers, and locally along the Copper River (Schrader and Spencer, 1901, p. 61; Mendenhall, 1905, p. 72). Smaller dunes are to be found locally along most glacial streams.

Cook Inlet

As the great Susitna–Cook Inlet glacier retreated northward during the waning stages of the Pleistocene epoch, conditions for silt deposition were probably at least as good as they are at present. Today the strong winds and frequent dust storms in the lowlands are well known (Tuck, 1938, pp. 652–3; Rockie, 1946, pp. 2, 6, 10, 23, 31–2). A considerable part, if not all, of the lowlands and lower flanks of the adjoining hills of Cook Inlet were probably covered with a blanket of eolian materials. On the alluvial bottoms and tidal flats the loess has been reworked, in swampy areas it has mingled with the organic deposits, and in the lakes it has been deposited as a lacustrine formation.

Sand dunes are relatively scarce because of abundant vegetation over most of the lowland. They occur along bluffs that are being eroded by water. Most are stabilized and are irregular in shape. Locally they may be as much as 50 feet high, but most are less than 20 feet (Rockie, 1946, p. 23).

The loess in the Matanuska Valley has been described by Tuck (1938) and Rockie (1946). Thor N. V. Karlstrom found that the thickness ranges from a few inches to 10 feet or more. Possibly the thickness depends on

conditions of deposition rather than on later erosion and may be correlated with the position and duration of static fronts during glacial retreat. Without doubt its source has been the broad braided streams issuing from the numerous glaciers in or adjacent to the lowland. Two distinct ash horizons in the loess and in glacio-fluvial deposits may prove useful as time indicators.

Bristol Bay

In the Bristol Bay area, Ernest H. Muller found that loess, containing two or more distinct ash layers, mantles the coastal lowland to a depth of 1 foot to 3 feet, except where it has been removed by streams or where, as one

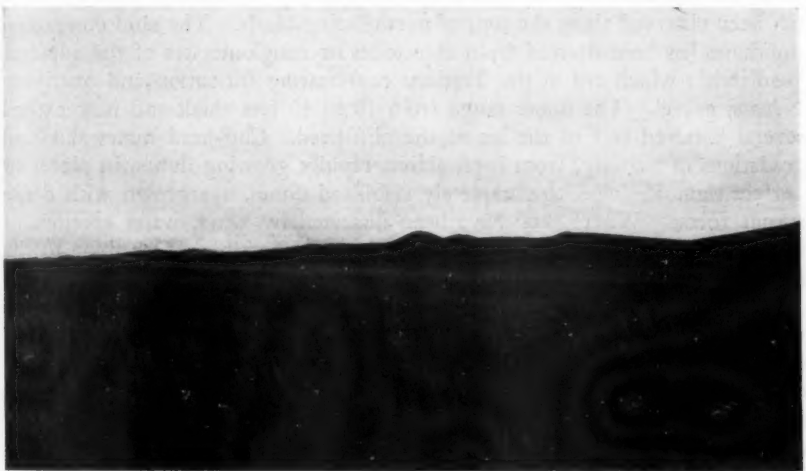

Photo: E. H. Muller, U.S. Geol. Surv.

Fig. 9. Coastal dune belt at Port Heiden, Bristol Bay, looking southwest from a point near Reindeer Creek, August 1949.

exposed morainic knolls, it has accumulated too slowly to maintain its identity. The loess generally lies on fluvioglacial sands and gravels from which it is clearly distinguished by texture, and was derived from the braided glacial streams that crossed the lowland and drained glaciers that almost surrounded the area.

Sand dunes up to 60 feet in height are found along sea bluffs, river bluffs, and past and present shorelines of the larger lakes (see Fig. 9). Active and stabilized fore dunes, commonly scarred with blowouts, are predominant. In places along the major streams the dunes form an "eolian levee" system 5 to 20 feet high. From the Naknek River to the northeast they are commonly covered with a spruce-parkland type of vegetation. The sand is medium-grained and well-sorted, passing into fine-grained sand and typical silt-loess within a few thousand feet from the river bank.

Small dunes are found in ash deposits on Aniakchak Volcano (Knappen, 1929, p. 206), and on the flanks of other volcanoes in the area (Howard

Waldron). Thick ash deposits on the flanks of volcanoes grade into thin ash layers of loess-like structure.

Spots of bared soil and blowout scars are abundant in the lowland wherever subsurface drainage permits seasonal drying of the soil.

Alaska Range

Eolian deposits are probably abundant throughout the Alaska Range though they have been mapped in the vicinity of the Alaska Railroad only. Clyde Wahrhaftig has provided the following information.

Sand dunes are restricted to the immediate vicinity of cliff-heads and lee-sides of "badland" areas, where they accumulate as true cliff-head dunes. They are present along the tops of all south-facing "badland" bluffs, but have not been observed along the tops of north-facing bluffs. The sand composing the dunes has been derived from sandstones or conglomerates of the adjacent "badlands", which are in the Tertiary coal-bearing formation and overlying Nenana gravel. The dunes range from 10 to 40 feet thick and may extend several hundred feet to the lee of the cliff-head. Cliff-head dunes show all gradations of stability, from bare, active, rapidly growing dunes, in places of perfect sigmoid shape, to completely stabilized dunes, overgrown with dense spruce forest. Where they have been dissected by wind, water erosion, or railroad cuts, up to three peat and forest layers are visible. One dune to the lee of a large outcrop of coal consists largely of coal fragments.

Angular platy fragments of schist, ½ inch thick and as much as 3 to 4 inches across, may be found in dune deposits at the tops of cliffs in the canyons of the Nenana and Totatlanika rivers. These must have been blown, rolled, or ricochetted by the wind for a distance of several tens of feet from their source in outcrops of schist to reach their present lodging places on top of, and interbedded with, thick turf, and in the branches of low bushes. They indicate extreme velocities of south winds.

Deposits of wind-blown silt mantle the slopes and tops of terraces along the Nenana River. The silt is 3 to 8 feet thick on bluffs overlooking the river, but thins away from the river. It thickens northward, increasing from 3 feet at Healy to 8 feet at Browne, 20 miles to the north. Commonly the silt is in two layers, a lower layer in which the bedding has been convoluted by frost action and the contained plant material is black, and an upper layer in which the bedding is undisturbed and the contained plant material is still brown and woody. Up to three peat layers may be present, and the boundary between the two types of silt is marked by a prominent peat layer. The median grain size of the upper silt layer is about 0.15 mm., whereas the median grain size of the lower silt layer, which has been affected by frost action, is 0.015 mm. The silt profiles on the higher and older terraces were not found to be thicker or more complex than those on the lower terraces.

The separate stratigraphic units of the silt mantle can be traced in many exposures from one terrace level to the next. The silt must therefore have been deposited following the development of all terraces. Inasmuch as the terraces can be traced upstream to glacial stages late in the Wisconsin, the silt deposits are all late Wisconsin or later.

Evidence on the rate of accumulation of the silt was obtained at two places. In the canyon between McKinley Park Station and Healy buried willow branches indicated an accumulation of 1 foot in about 50 years. At Healy a metal container buried under 8 inches of silt and exposed on the edge of the river bluff indicated a rate not less than 1 foot in 60 years.

Other areas

David M. Hopkins reports that very small dunes are active on recent beaches of several lakes in the interior of Seward Peninsula. The dunes are mostly blowouts and are generally less than 5 feet high and 10 to 20 feet long. Fine silts, believed to be largely wind-deposited, are widespread in the southwestern part of Seward Peninsula adjacent to the Kigluaik Mountains. The silts overlie glacial outwash deposits in valley bottoms and are locally present on the adjacent bedrock slopes. The deposits are 1 foot to 10 feet thick. The silts are believed to have been deposited during ice advances of several ages but present data are insufficient to subdivide either the glacial deposits or the associated silts.

George Gryc reports that poorly developed longitudinal dunes and active blowouts are common in north-facing valleys above 2,000 feet in the Brooks Range. All valleys have been extensively glaciated and filled with glacial debris, the source of the eolian material. Some terraces are reported to be covered with silt of possible eolian origin.

Ray (1935, Fig. 12) shows a photograph of a ripple-marked sand dune in the outwash plain of the Mendenhall Glacier, southeastern Alaska. It is now believed to be destroyed, but it is thought that sand dunes have existed on the outwash plains of many of the larger glaciers in southeastern Alaska and that silt has been picked up by the wind and deposited near the glacial streams. However, the torrential rainfall and the meandering streams tend to destroy all such deposits almost as soon as formed, and if any survive they are soon covered by luxuriant vegetation.

Dunes and loess are reported from many other glacial valleys but are not shown on Fig. 1 as their locations are not known.

Coastal Margins

Coastal margins along the Gulf of Alaska, the Aleutians, the Bering Sea and Bering Sea islands, and Seward Peninsula northward along northern Alaska, are characterized by fore dunes and irregular small blowouts. Isolated or continuous dunes of various types are common. The location and size of isolated dunes or dune belts are determined by the direction and velocities of seasonal winds, the degree of protection from marine erosion, and the supply of sand. Though precipitation and other climatic factors and local geology vary widely, at least a limited amount of sand is available locally to seasonal winds in exposed bars and beaches. At most places heavy rainfall, or persistent light rains, fog, high humidity, clouds, and vegetation discourage wind transportation. Hence, most dunes extend inland only a few hundred feet though some form belts a mile wide (see Fig. 9).

In the Gulf of Alaska, especially between Cape Suckling and Icy Bay and adjacent to the Malaspina Glacier, there may be three or more ancient beach ridges, topped by dunes, behind the present beach (Don J. Miller). The ridges, being better drained, are covered with timber; the intervening areas of lagoon deposits are swampy. The dunes may extend for many miles but cover a very small area. The average thickness measured from sea level to the top of the dunes is 20 feet, and the maximum thickness about 80 feet. Only part of such beach-dune ridges is wind-transported material. The wind produces fore dunes, blowouts, and transverse dunes. Those along the present beach are active; those on the ancient beach ridges are stabilized.

Locally on some islands in the Copper River distributary (Tarr and Martin, 1914, p. 466) and on the coast east of Cape Suckling, longitudinal and other types of dunes are several tens of feet high. Most are partly active though vegetation is abundant.

Isolated areas of wind-blown sand and small dunes just above high tide are found on many of the Aleutian Islands and the Alaska Peninsula (Smith and Baker, 1924, p. 188; Knappen, 1929, p. 206; Griggs, 1936, pp. 389–90; Byers, *et al.*, 1947, p. 35; Simons and Matheson, 1947, p. 64; Coats, 1947a, p. 83; 1947b, p. 102). Judson (1946) has studied in some detail an area of dunes on Adak. Single fore dunes and dune belts, modified by blowouts, are most common (Howard A. Powers, *et al.*). Their composition and form vary widely. Frank M. Byers writes that a dune belt 3 miles long and 600 feet wide lies on glacio-fluvial material on the north coast of Shemya. Robert R. Coats mentions that loess composed of reworked ash is absent or very scarce on most Aleutian Islands, but is 5 to 6 feet thick in stream valleys on Kiska Island. Coats also mentions that small dune ridges similar to those on Seward Peninsula (see below) in a few places in the Aleutians, for example on Tanaga Island.

Isolated fore dunes and occasional longitudinal dunes are found on the wet, wind-swept Bering Sea islands, but little is known about them. Most are built in vegetation and actually encroach on the tundra as much as one mile from the shore. Blowouts are numerous.

David M. Hopkins has made detailed notes of eolian deposits on Seward Peninsula, and the following account is largely quoted verbatim from his unpublished summary.

Much of the coastline of Seward Peninsula is smooth and straight, with broad sandy beaches. Active eolian formations are present everywhere along these beaches, and are especially well developed in the areas between Solomon and Point Spencer and between Cape Prince of Wales and Cape Espenberg.

The most common dunes, consisting of crescent-shaped hillocks of sand, 3 to 10 feet high and 8 to 20 feet long, should probably be termed parabolic. These are found at the top edge of escarpments carved in overgrown beach ridges by recent storm waves. They are generally elongate parallel to the shore and slightly convex towards the sea. The shoreward slopes of bare sand are steep and undergoing active deflation. The landward depositional slopes are gentler, with generally a fairly complete cover of wild rye

(*Elymus sp.*). All the dunes observed appear to be formed by onshore winds and do not reflect any constant regional wind direction.

Small barchans, 1 to 1½ foot high, and small "climbing" or "cliff" dunes are present locally on exceptionally wide beaches composed of very fine sand. They are found between the level of normal high tide and the ridge or escarpment carved by the highest storm tides, and are especially well developed at Port Safety, east of Nome.

Oval blowout areas undergoing active deflation are conspicuous on the Bering coast about a mile north of Cape Woolley. They are about 200 feet wide and 500 to 1,000 feet long. One area is indented about 8 feet below the general level of the surrounding terrain, but others only a few inches. The long axes of the blowouts trend north-northeast to south-southwest at an angle of about 50 degrees to the present coastline, which therefore truncates each of the oval areas.

A few small rounded dunes several feet high, which support a sparse cover of *Elymus*, are scattered over the surface of the blowouts. The remainder of the surface area is covered with small "dunes" of a type not previously encountered by Hopkins. They consist of broadly sinuous asymmetrical ridges extending discontinuously across the width of the blowouts. The ridges are 6 to 24 inches high and spaced at intervals of about 5 feet. The south sides have an average slope of 12 degrees but range in slope from 3 to 20 degrees, and are covered by a dense mat of *Dryas-Arenaria* turf. The north slopes range from nearly vertical to slightly overhanging and consist of bare sand apparently undergoing active deflation. The roots of the plants composing the turf are exposed in the escarpments and several buried turf layers may also be exposed in the underlying sand. Areas of bare sand are present in the hollows separating the dunes. The orientation of the turf dunes indicates that they are carved by winds blowing from N.5°E. to N.15°E.

The surface material in the vicinity of the deflated areas at Cape Woolley consists of coastal plain sediments. Silt containing varying quantities of organic matter is the dominant constituent but linear bodies of sand, probably representing elevated beach deposits, are common. The deflated areas appear to coincide with the areas of surface sands, and the orientation of the blowouts may be determined by the orientation of the linear sand bodies, rather than by the direction of strong winds. The orientation of the turf dunes is slightly oblique to the trend of the blowouts and is believed to reflect the direction of strong winds more accurately. Silt is also being distributed from bare floodplains of small streams near the coast.

Along the Bering and Arctic coasts of Seward Peninsula, stabilized dunes have been recognized on ancient beach ridges only. Ancient strand lines with stabilized dunes have been recognized at Solomon, Point Safety, between Cape Woolley and Point Spencer, and at many localities between Cape Prince of Wales and Cape Espenberg. Nondescript oval dunes are the most common form, but parabolic dunes are fairly common along the Arctic coast, particularly near Cape Espenberg. The larger stabilized dunes at Cape Espenberg

are pockmarked with small active blowouts and appear to be undergoing destruction by recent winds.

On the offshore bars and beaches northward from Seward Peninsula to Barrow, plants, predominantly *Elymus mollis*, catch the drifting sand and build irregular to oval mounds a few inches to many feet high (see Fig. 10), but the quantity of sand is limited and no large coastal dunes form. Typical "desert pavements" are developed locally. The larger exposed rock fragments, commonly chert, are wind-polished and -faceted. Blowouts are abundant in

Fig. 10. Rounded and irregular dunes formed by *Elymus mollis* on an offshore bar at Peard Bay, northern Alaska, 4 August 1947.

the dunes on the bars and along the coastal bluffs. From Cape Beaufort to Peard Bay the unconsolidated superficial deposits are predominantly sands. Fine sand and silt become increasingly abundant in the bluffs to the north, and are commonly exposed along the tops of the bluffs where vegetation has been removed by wind action. Small blowouts a few feet to several tens of feet in diameter and generally a few inches deep occur during dry summers.

Ventifacts

Troy L. Péwé notes ventifacts cut by sand-blast action, in the valley of the Delta River in central Alaska. They were formed, and apparently are still forming, on ridges exposed to strong south winds. Those in younger moraines are less well developed than those in older moraines. Ernest H. Muller mentions that in the Bristol Bay coastal lowland ventifacts are buried in glacial outwash and can be found on the top of moraines. Clyde Wahrhaftig reports that wind-polished and -faceted pebbles and boulders are common in exposures

of old till on terraces above Healy and on some south-facing slopes in adjacent "badland" areas in the Alaska Range.

Earlier workers have probably observed ventifacts in numerous other areas in Alaska, for example Smith and Mertie (1930, p. 249) in northern Alaska. However, such observations are generally not recorded and ventifacts are probably more widespread than published references suggest. It is likely that ventifacts occur in many of the mountainous areas, as Péwé and Wahrhaftig have reported for their areas, for high winds are common in the passes. Similarly, high winds are characteristic of the coastal margins and no doubt future investigators will find many places where wind-faceted pebbles and boulders are common.

Ash Deposits

Ash deposits are known in most major regions of Alaska, except northern Alaska. However, only in the Alaska Peninsula and adjacent islands, in the Aleutians, and in parts of the upper Tanana and White rivers do they make up an appreciable proportion of the soil. Their distribution, character, and genesis are only partly known, yet numerous references to them exist in the literature. As the ash falls have no known close climatic significance or correlation with the present eolian deposits, except as age indicators, they are not described in detail. Smith (1939, pp. 79-88) summarizes vulcanism during Tertiary to Recent time and describes the main ash falls in Alaska. Robinson (1947) gives more recent information for the Aleutians, where one to two volcanic eruptions are expected each year, and where most surface material is ash. It is apparent that the light pumiceous ash of andesite in the upper White and Yukon rivers, described in detail by Capps (1915), and the ash from the eruption of Mount Katmai in the Alaska Peninsula described by Griggs (1922), are by far the most outstanding ash falls known in Alaska. The former is estimated to cover more than 140,000 square miles and has a total volume of ash of about 10 cubic miles; it took place possibly 1,400 years ago. The latter occurred in 1912, and about 4¾ cubic miles of ash was ejected.

Thor N. V. Karlstrom has found that two ash layers buried to a depth of a few inches to several feet in the superficial deposits in many parts of the Cook Inlet area, are ½ to 1 foot apart in loess and peat. Two thin ash layers are found in the Bristol Bay lowland (Ernest H. Muller), one at the base of the litter[1] and the other 3 to 6 inches lower. These may prove to be potential horizon markers and, with those in Cook Inlet, may possibly be correlated with explosions from Mount Katmai and other volcanoes.

Reed and Coats (1941, pp. 47–8) describe a widespread ash fall from Mount Edgecumbe, near Sitka, in southeastern Alaska, which blankets recent morainic deposits but has been removed by erosion from many exposed places.

David M. Hopkins mentions that, throughout the eastern part of the coastal plain of northern Seward Peninsula, ash from Devil Mountain is probably interbedded with or overlies the coastal plain sediments. In central Seward Peninsula there are several small cinder cones which have thin, discontinuous layers of ash at the surface. Thick peat sections within a radius

[1]The upper, only slightly decomposed part of the forest floor.

of 10 miles from Imuruk Lake generally include a zone exceptionally rich in silt, which ranges from 3 to 18 inches thick and lies at a depth of 6 to 18 inches. The inorganic material consists almost entirely of shards of colourless volcanic glass, but includes a small percentage of broken crystals. The zone is believed to have originated from an ash fall but may possibly represent loess.

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MACKENZIE
DISTRICT OF
AMUNDSEN GULF
Arctic Circle
Arctic Circle
Parry River
Bathurst Inlet
Coppermine
Port Radium
Great Bear Lake
Fort Good Hope
Norman Wells
Wrigley
Fort Simpson
Fort Providence
Fort Resolution
Fort Smith
Fort Reliance
Yellowknife
Rae
Great Slave Lake
Hay River
Whitehorse
Aklavik
Reindeer Station
Carcajou Hills
Arctic Red River
Peel River
Anderson River
Mackenzie Bay
Beaufort Sea
Kendall River
Richards Island
Kugmallit Bay
Liard River
Great Bear R.
Dubawnt Lake
Thelon Game Sanctuary
Flight Lines 1946-9
Field Stations

NOTES ON THE MAMMALS OF THE MACKENZIE DISTRICT, NORTHWEST TERRITORIES

A. W. F. Banfield*

ALTHOUGH there are several accounts of the mammals of the Mackenzie District, notably those of Preble (1908), Porsild (1945), and Clarke (1940), such literature is still sufficiently scarce for the following notes on the distribution of mammals to be worth recording. The observations were made in the course of other field investigations undertaken in the Northwest Territories since 1946 for the Canadian Wildlife Service.

A preliminary investigation of the muskrat resources of the Mackenzie delta was carried out between 15 July and 17 August 1946. At this time brief observations were made at the airfields in the Mackenzie valley. In the delta, camps were established at Aklavik, the Reindeer Station, and Richards Island. Small mammal traps were set at the Reindeer Station.

In 1948 and 1949 extensive field work was undertaken in connection with the barren ground caribou investigation (Banfield, 1950), and much information was obtained from numerous low level flights over the eastern part of the Mackenzie District. Throughout the summer field trips I was assisted by Mr. A. L. Wilk.

Intensive studies and small mammal trapping was carried out at the following stations for the periods listed:

Clinton-Colden Lake, 6 July–3 September 1948;
Muskox Lake, 19–23 July 1948;
Yellowknife, 21 April–2 May 1949;
Fort Smith, 18–25 June 1949;
Fort Reliance, 25 June–11 July 1949;
Bathurst Inlet, 12 July–1 August 1949;
Contwoyto Lake, 1–20 August 1949.

During the summer of 1948 two canoe trips were made from Clinton-Colden Lake, one on the Back River and the other on the Hanbury River.

The following annotated list is based on a collection of 80 mammal specimens of 19 species and on observations. The Mackenzie delta specimens were donated to the National Museum of Canada, the remainder are in my private collection. The nomenclature is that of Anderson's 'Catalogue of Canadian recent mammals' (1946), except in the following cases where I have followed the authors indicated:

Ursus americanus (Hall, 1928);
Phenacomys intermedius mackenzii (Crowe, 1943);
Clethrionomys rutilus dawsoni (Rausch, 1950);
Microtus oeconomus macfarlani (Rausch, 1950);
Alces americana andersoni (Peterson, 1950).

Where the precise determination of specimens is impossible because of the

*Canadian Wildlife Service.

lack of adequate material the scientific identification has been presented in as detailed form as is thought justifiable.

The Mackenzie District contains two major biotic formations in which mammals occur: the tundra and the taiga or boreal forest biomes. These observations deal with the fauna of both formations. The smaller mammals are generally restricted to one formation although there may be some marginal overlapping. Many of the larger mammals, although showing a distributional preference for one formation, are often found in both.

Sorex cinereus ugyunak Anderson and Rand. Arctic Long-Tailed Shrew.

This shrew seems to have a widespread though localized distribution on the tundra. Four specimens were secured during August 1946 from traps set in a ravine in a dense growth of willows, alders, and birch in the Caribou Hills behind the Reindeer Station. Mr. M. Murphy of Muskox Lake gave me four mummified carcasses of shrews on 20 July 1948, which he had found during the spring cleaning of his sod cabin. Three had the dark dorsal band and grey flanks which fit well the original description of the subspecies. The fourth had a more buffy pelage which possibly indicated a seasonal difference. The skulls were typical of the species.

Ursus sp. Barren Ground Grizzly Bear.

A dark-coated grizzly bear was seen from the air on a tundra lake about fifty miles west of Contwoyto Lake on 4 May 1948. At Contwoyto Lake two grizzly hides were secured from the Eskimo. Both hides were generally buff coloured with reddish fur on the limbs. Mr. Frank Knox of Fort Reliance reported that two grizzlies had been troublesome about his meat caches at Ptarmigan Lake during the fall of 1948.

Ursus americanus Pallas. Black Bear.

Bear tracks and claw marks were noted near Fort Reliance. Part of a skull was found at the Indian campsite at the mouth of the Lockhart River.

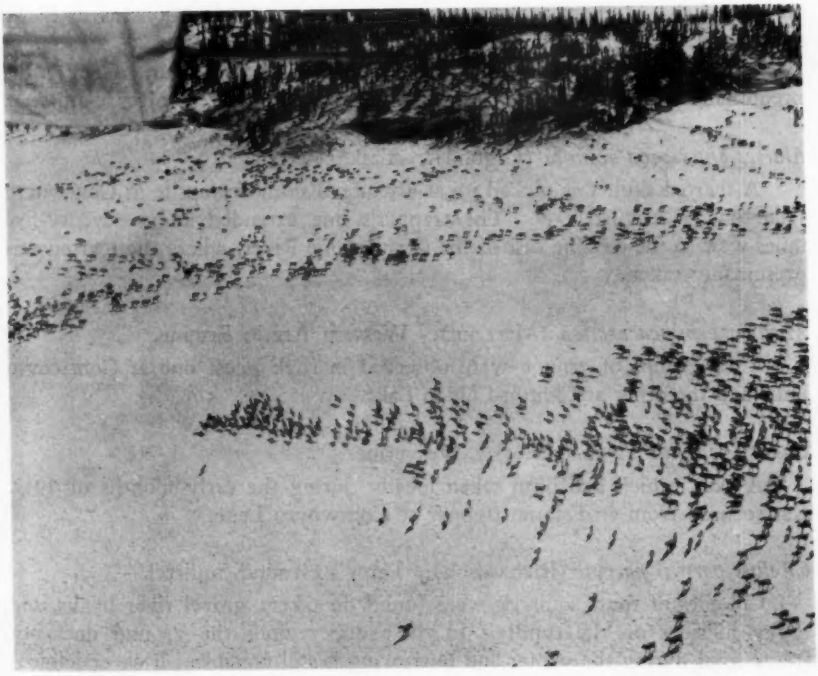
Vulpes fulva alascensis Merriam. Alaska Red Fox.

Native and white trappers interviewed reported that the red fox had increased in recent years on the tundra. It was reported at Bathurst Inlet and Muskox Lake. A cross fox was observed at Contwoyto Lake on 16 August 1949.

Alopex lagopus innuitus (Merriam). Continental Arctic Fox.

Eleven skulls of this fox were secured from an Eskimo winter camp at Contwoyto Lake. Fox tracks were noted along the upper Back River and along the upper Hanbury River. On 25 August 1948 a fox den was discovered in a rocky talus at Clinton-Colden Lake. Attention was drawn to the spot by the yapping of the two whelps. They were clove-brown dorsally and the colour extended in strips down the legs. The under parts were creamy-yellow, and this colour extended on to the flanks. During the following days the

String of caribou crossing Ghost Lake during the spring migration.



Aerial view of a wolf in pursuit of migrating caribou at Ghost Lake.

antics of the whelps, which were remarkably fearless, were photographed at close range. The adults were never seen, although they visited our camp regularly at night and stole our meat and drying specimens.

Canis lupus ssp. Wolf.

During our field trips on the tundra in summer, wolves or their tracks were seen at all stations. The population was not evenly distributed. On extensive flights it was noted that large areas of the northern coastal tundra seemed to be nearly devoid of wolves while the tundra in the vicinity of the treeline appeared to support a large population. Eskers were favourite locations for den sites. A freshly abandoned den was found on an esker at Sussex Lake on 15 July 1948 with nearby the skeleton of a wolf which appeared to have been eaten by other wolves. The skull of another wolf was secured at Bathurst Inlet.

In the late summer individual wolves were observed following in the train of migrating caribou herds at Contwoyto Lake, Aylmer Lake, Clinton-Colden Lake, and the Hanbury River. In early spring packs of wolves were seen following and feeding on the migrating caribou herds in the coniferous forests of the Mackenzie basin, the upper Snare River, Artillery Lake, the upper Thelon River, and Sid Lake. Flights over the tundra at this time of year showed little sign of wolves or their tracks. It seems likely that many of the wolves of the Mackenzie District carry out seasonal migrations as extensive as those of the barren ground caribou themselves.

The wolves of the district show wide variations in colour. Grey is the predominant colour but black, cream coloured, and white wolves were seen.

Martes americana actuosa (Osgood). Alaska Marten.

A marten skull was picked up at a winter Eskimo campsite at Contwoyto Lake on 15 August 1949. The trapper's line extended about seventy-five miles west to the treeline east of the Coppermine River, where the marten was presumably taken.

Mustela erminea arctica (Merriam). Western Arctic Ermine.

Two groups of ermine were observed in rock piles: one at Contwoyto Lake and the other at Clinton-Colden Lake.

Gulo luscus luscus (Linnaeus). Wolverine.

A skin, which had been taken locally during the early months of 1949, was secured from an Eskimo trapper at Contwoyto Lake.

Citellus parryii parryii (Richardson). Parry's Ground Squirrel.

Colonies of these squirrels were found on eskers, gravel river banks, and rocky hillsides on the tundra. In these dry regions the ground does not freeze solid during the winter and burrowing is still possible. Two specimens were secured at the Reindeer Station, one at Contwoyto Lake, and one at

Sussex Lake. Ground squirrels were also observed at Bathurst Inlet, Perry River, Muskox Lake, Aylmer Lake, and the Hanbury River.

Eutamias minimus borealis (Allen). Northern Interior Chipmunk.

This diminutive squirrel is confined to the southern part of the Mackenzie basin. Two specimens were collected at Fort Smith; others were observed at Hay River and Fort Simpson. None was seen at Yellowknife or Fort Reliance.

Tamiasciurus hudsonicus preblei Howell. Mackenzie Red Squirrel.

Red squirrels are common throughout the whole forested region of the district even to the treeline. One was secured at Fort Reliance and one at Fort Smith. They were observed also at Yellowknife, Artillery Lake, Fort Simpson, Wrigley, Norman Wells, and Aklavik.

Castor canadensis canadensis Kuhl. Canada Beaver.

The beaver is fairly common in the Mackenzie delta, where lodges and animals were seen north of the Reindeer Station. On flights over the southern part of the Mackenzie District scattered lodges were observed in the Nonacho Lake and Snowdrift River areas.

Peromyscus maniculatus borealis Mearns. Mackenzie White-footed Mouse.

The white-footed mouse inhabits the taiga biome of the Mackenzie basin. Three specimens were secured at Fort Reliance.

Lemmus trimucronatus alascensis Merriam. Alaska Brown Lemming.

Lemmings were nowhere common during the seasons when these investigations were carried out. One Alaska Brown Lemming was secured on Richards Island at the mouth of the Mackenzie River in 1946.

Lemmus trimucronatus trimucronatus (Richardson). Brown Lemming.

Three brown lemmings were secured at Clinton-Colden Lake. This lemming was also observed at Bathurst Inlet, Aylmer Lake, and Contwoyto Lake.

Dicrostonyx groenlandicus kilangmiutak Anderson and Rand. Mackenzie Varying Lemming.

Varying lemmings show a seasonal change in habitat in this district. During the winter months they build tunnels and nests under the snow banks. In summer they move to well drained slopes on higher ground, inhabiting shallow systems of burrows among the boulders. In the fall they return to the lower areas and the protection of the snow banks, and at this time some seem to wander out on the newly formed ice. Two carcasses were seen on the thawing ice off shore from Bathurst Inlet. In May 1948 carcasses were noted about two hundred yards off shore from Churchill, Manitoba. During July 1948 colonies, which had probably been established by such fall wanderings, were seen on islets in Clinton-Colden and Aylmer lakes. Three specimens

Aerial view of a herd of caribou, Ghost Lake. From the aircraft it could be seen that the herd was surrounding a single wolf.

were taken at Contwoyto Lake and one at Bathurst Inlet and others were also observed at Perry River.

Phenacomys intermedius mackenzii (Preble). Mackenzie Phenacomys.

Three specimens of this rare vole were trapped on the forest edge at Fort Reliance.

Clethrionomys rutilus dawsoni (Merriam). Dawson's Red-backed Vole.

Three typically bright-coloured specimens of the red-backed vole were secured in the taiga habitat at Fort Reliance. This vole also seems to be widely distributed on the tundra. A series of ten specimens was secured at Clinton-Colden Lake during the summer of 1948. Others were identified at Bathurst Inlet, Contwoyto Lake, and Muskox Lake. The Clinton-Colden series is much darker than the Fort Reliance specimens and the palatine bridge of the skull is also more widely interrupted. The tundra red-backed voles may represent an undescribed subspecies of the *rutilus* group and may be ecologically isolated from the taiga form.

Microtus pennsylvanicus drummondii (Audubon and Bachman). Drummond's Meadow Vole.

This vole is widely distributed in suitable meadow habitats in the taiga and seems to have spread to the tundra in the southern part of the Mackenzie

District. A single specimen was secured at each of the following places: Reindeer Station, Fort Reliance, and Clinton-Colden Lake.

Microtus oeconomus macfarlani Merriam. Macfarlane's Tundra Vole.

Three specimens of this large grey vole were secured from runways around the buildings at Bathurst Inlet.

Ondatra zibethica spatulata (Osgood). Northwestern Muskrat.

Throughout the taiga muskrats are widely distributed wherever shallow ponds and lakes contain suitable food. They are extremely common in the Mackenzie delta, where they occur beyond the treeline. Five were taken at Aklavik and one at the Reindeer Station, and they were observed at Fort Reliance and Fort Smith.

The Mackenzie delta muskrats were found to carry a prevalent liver infestation of coenuri of an unidentified tapeworm.

Erethizon dorsatum dorsatum (Linnaeus). Porcupine.

Corporal Ivan Ralston of the R.C.M.P., when in dire need, shot and ate a porcupine east of Lynx Lake in February 1949. The porcupine was taken in a small isolated group of spruce at the treeline.

Lepus arcticus andersoni Nelson. Barren Grounds Hare.

Arctic hares are widely distributed on the tundra but are only abundant locally. Two young hares were discovered in a rocky talus on the shore of Clinton-Colden Lake on 6 July 1948. They were also common and fearless about our camp there, and as many as five were feeding about the tent during the twilight hours of August.

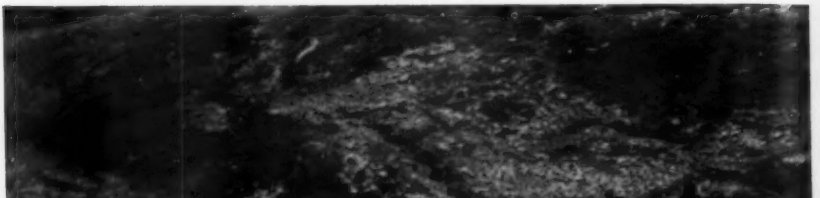
Lepus americanus macfarlani Merriam. Mackenzie Varying Hare.

At the time of my field trip in 1946 the varying hare population in the Mackenzie delta had just crashed from a peak during the preceding winter. In July hares were still very common in the delta region. The numerous faeces and extensive girdling of willows and alders indicated the great density of the winter population. Three carcasses were found. Cursory examination failed to show any significant internal lesions, but one sick animal was examined which had a creamy exudate from the eyes matting the hair of the face.

Alces americana andersoni Peterson. Northwestern Moose.

Moose are widely distributed in suitable habitats in the taiga and they also occur on the tundra in the vicinity of the treeline. In regions where hunting is not heavy they may be locally abundant. During the present field investigations moose were seen in the Mackenzie delta, on the upper Yellowknife River, and on the Lockhart River. A moose skull was examined at the Indian camp at Fort Reliance.

Mr. Robert Smith of the U.S. Fish and Wildlife Service reported numerous moose seen from the air in 1949 between the head of the Eskimo Lakes and Liverpool Bay.



A herd of thirty-five muskoxen seen from the air at Arctic Sound.

Rangifer arcticus arcticus (Richardson). Barren Ground Caribou.

The barren ground caribou is a nomadic inhabitant of the tundra and the taiga of the eastern part of the Mackenzie District. Large herds generally spend the winter months in the forest about the great lakes of the Mackenzie basin. During the early summer these herds are usually dispersed on the tundra. Specimens, mostly skulls, were collected at Fort Reliance, Clinton-Colden Lake, Contwoyto Lake, Bathurst Inlet, and Sussex Lake. A special report on the barren ground caribou investigation will be published later.

Rangifer caribou sylvestris (Richardson). Western Woodland Caribou.

Mr. Robert Smith reported seeing a small group of caribou from the air on the northwest shore of Great Slave Lake in July 1949. As this was out of the range of the barren ground caribou they were assumed to be woodland caribou.

Bison bison Linnaeus. Bison.

Three bison were observed on the salt plains northwest of Fort Smith.

Ovibos moschatus moschatus (Zimmerman). Barren Grounds Muskox.

During the extensive reconnaissance flights over the tundra for the caribou investigation, every opportunity was taken to gather data on the distribution

of continental muskox. Muskoxen were observed at the following localities: upper Tree River (8); Arctic Sound (40); Hood River (1); west branch of the Burnside River (3); Contwoyto Lake (10); Aylmer Lake (17); Clinton-Colden Lake (1). Reliable reports of recent observations from the following localities were secured from northern pilots: Tree River mouth (15); Grays Bay (40); Galena Point (40); Bathurst Inlet (1); Thelon River (90); Consul River; Simpson Peninsula (50); Wharton Lake.

From these observations it is evident that a pocket of muskoxen, numbering between 100 and 200 animals, exists in the exceedingly rough country bordering Coronation Gulf between the Tree River and the Hood River. Other scattered bands, perhaps 50 individuals in all, inhabit the headwaters region of the Burnside River. Elsewhere, muskoxen seem to be maintaining themselves in and about the Thelon Sanctuary. The herd observed at Aylmer Lake consisted of 1 bull, 8 cows, 3 yearlings, and 5 calves, which indicated an excellent increase.

From information obtained on many flights it seems unlikely that muskoxen occur at present in the Kazan and upper Dubawnt river systems or in the terrain between Bathurst Inlet and Perry River. Nor have they been recently observed on the upper reaches of the Thelon or Back rivers.

Muskoxen appear to take part in local seasonal migrations. During the summer months herds were observed along the river valleys and lake shores browsing on the dwarf birch (*Betula glandulosa*). During the winter months they were seen in rough hilly country where the winter winds had blown the steep rocky slopes clear of snow. Aerial surveys of the Thelon valley in April and May failed to locate muskoxen or their tracks in areas where they were reported by Clarke (1940) as being common in summer.

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REMARKS ON THE TIDES AND DRIFTWOOD STRAND LINES ALONG THE EAST COAST OF JAMES BAY

T. H. Manning

On 24 June 1950 A. H. Macpherson and I left Moosonee by canoe and, after stops of over two weeks at Moar and Paul bays, we arrived at Long Island on August 8. We began the return journey three days later, made several stops of a few days each at various places on the east coast of James Bay, and arrived back in the Moose River on September 7. The primary purpose of the trip was a study of the birds and mammals along the northern parts of the coast but, whenever possible, we set up a tide scale and took readings as frequently as our other work permitted.

Normally, readings were taken at irregular intervals of half an hour to four hours from about 0700 to 2100 EST. Owing to our other work it was not practicable to take night readings. Lack of these is not of great consequence north of the Paint-hills Islands, as the tide there is of the synodic type with relatively small diurnal inequalities. South of the Paint-hills Islands, however, and particularly in the Moar Bay area, where the tide appears to be primarily declinational with a marked diurnal inequality and a small range, apparently much affected by the wind, the height and time of the night tides is doubtful.

Fig. 1 shows Eastern Standard Time and the height in feet of high and low water at all places (except Moar Bay) where readings were taken. These figures are derived graphically from the tidal curves, and are given only when these could be drawn with reasonable exactness for the periods of high and low water. The high water lunitidal interval in this table is the interval between the moon's transit at Greenwich and the Greenwich mean time of high tide.

The longest series of readings north of the Paint-hills Islands was taken at Paul Bay. There, the mean Greenwich lunitidal interval, derived graphically from a plot of the semi-diurnal records, was about 40 minutes, with a maximum interval a day or two after full and change, and a minimum three or four days before full and change. The lunitidal intervals of seven high tide readings obtained at the Roggan River fall closely along the projected curve of the Paul Bay intervals, and there appears therefore to be no difference in the time of high water at these two places. Our three high water readings at Long Island suggest that here also the average lunitidal interval is about the same or a shade smaller than at Paul Bay. South of Paul Bay, high water appears to be slightly later since the lunitidal intervals at Stromness Harbour, Walrus Peninsula, and Pointe au Huard are all about 20 minutes larger than those for

Date	Moon	GMT	High Tide EST	High Tide GLTI	High Tide Feet	High Tide EST	High Tide GLTI	High Tide Feet	Low Tide EST	Low Tide Feet	Low Tide EST	Low Tide Feet
July 13.....	N											
July 15.....	●	0505										
Two miles north of Pointe au Huard												
July 16.....												2.0*
July 17.....			1040	1:34	4.9							
Paul Bay (near Piagochiwi River)												
July 20.....	E											
July 22.....	☽	1050				1340	0:40	6.9			2000	1.5
July 23.....						1420	0:25	7.1	0810	1.5	2040	1.7
July 24.....						1510	0:20	6.9	0920	1.6		
July 25.....	P					1615	0:20	6.9	0950	1.8		
July 26.....	S					1710	0:10	7.2	1115	1.9		
July 27.....						1820	0:20	7.5				
July 28.....			0720	0:50	7.3	1925	0:25	8.0			1330	2.6
July 29.....	○	0417	0835	1:05	7.9	2045	0:50	8.2			1440	2.7
July 30.....			0920	1:00	7.8	2140	0:55	8.2			1530	2.2
July 31.....			1010	1:00	7.6						1620	1.7
Aug. 2.....	E		1140	1:10	7.0						1740	0.9
Aug. 3.....						1220	1:05	7.0		0.6	1810	0.6
Aug. 5.....	A ☾	1956				1325	0:50	6.5		1.2	1930	1.3
Aug. 6.....						1400	0:40	6.8	0740	1.4		
Long Island												
Aug. 8.....						1505	0:05	4.5				
Aug. 9.....	N					1610	0:15	4.5	1010	1.4		
Aug. 10.....					4.6	1720	0:30	3.8	1130	0.8		
Roggan River												
Aug. 11.....						1830	0:50					
Aug. 12.....			0700	0:50		1925	0:50	5.4			1330	1.3
Aug. 13.....	●	1648	0810	1:10	4.8						1445	0.9
Aug. 14.....			0900	1:10	5.0						1500	−0.2
Aug. 15.....			0935	1:00	5.8						1530	0.3
Aug. 16.....	E		0950	0:30	6.6							
Stromness Harbour												
Aug. 20.....	P											
Aug. 22.....	S											
Aug. 25.....						1820	0:35	6.1			1230	2.3
Aug. 26.....			0735	1:25	5.0	1940	1:05	4.8			1330	0.6
Southeast side of Walrus Peninsula												
Aug. 27.....	○	1451				2040	1:20	5.9			1410	0.9
Aug. 28.....			0910	1:25	5.7						1530	1.1
Paint-hills Islands (south side)												
Aug. 29.....	E										1930	1.0
Aug. 30.....						1300	3:50	1.9	0740	0.2	2030	0.7
Aug. 31.....						1330	3:40	2.5	0800	0.7	2030	1.7
Sept. 1.....					3.3	1330	2:60	2.6	0900	1.3		
Spit Island												
Sept. 3.....	A					1705	5:00	2.5				
Sept. 4.....	☾	1353	0700	6:35	2.2	1730	4:40	2.3			1210	0.6
Loon Point												
Sept. 5.....						1940	5:55	2.4				
Sept. 6.....	N		0920	7:10	3.6			4.2+			1355	1.8

*approximately.

Fig. 1. Height of high and low water at places in east James Bay derived from the tidal curves. Note: the times given under GMT are the times of new, half, and full moon respectively. All other times are to the nearest 5-minute interval. The heights given for high and low water are the original readings taken on the tide scale which was necessarily set at a different datum at each place.

GMT = Greenwich Mean Time
EST = Eastern Standard Time
GLTI = Greenwich Lunitidal Interval

N = Maximum North Declination
S = Maximum South Declination
E = Moon on Equator (Declination 0°)

P = Perigee
A = Apogee

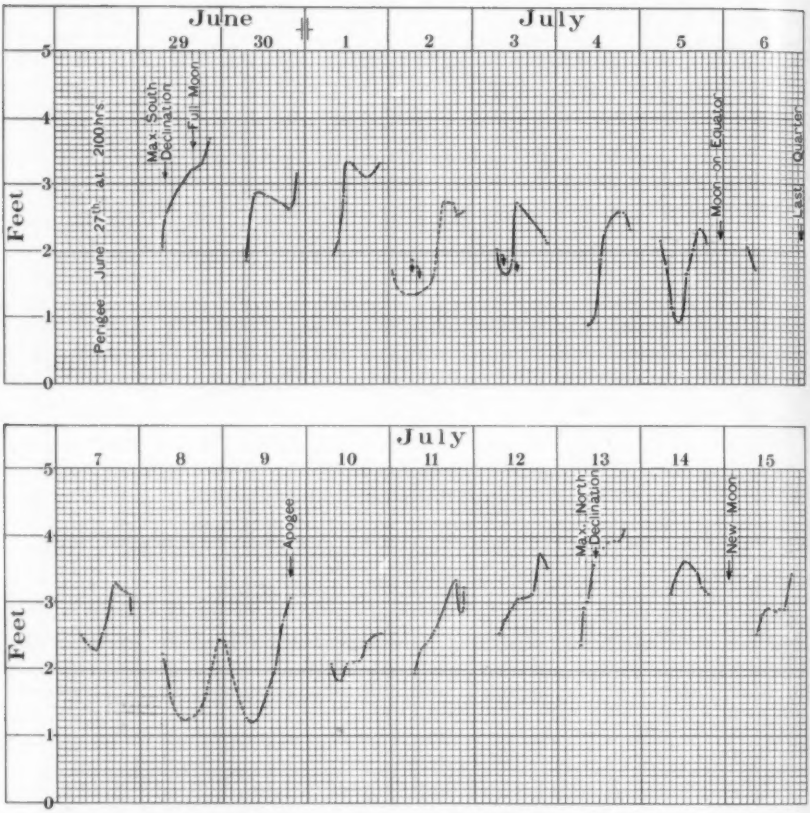
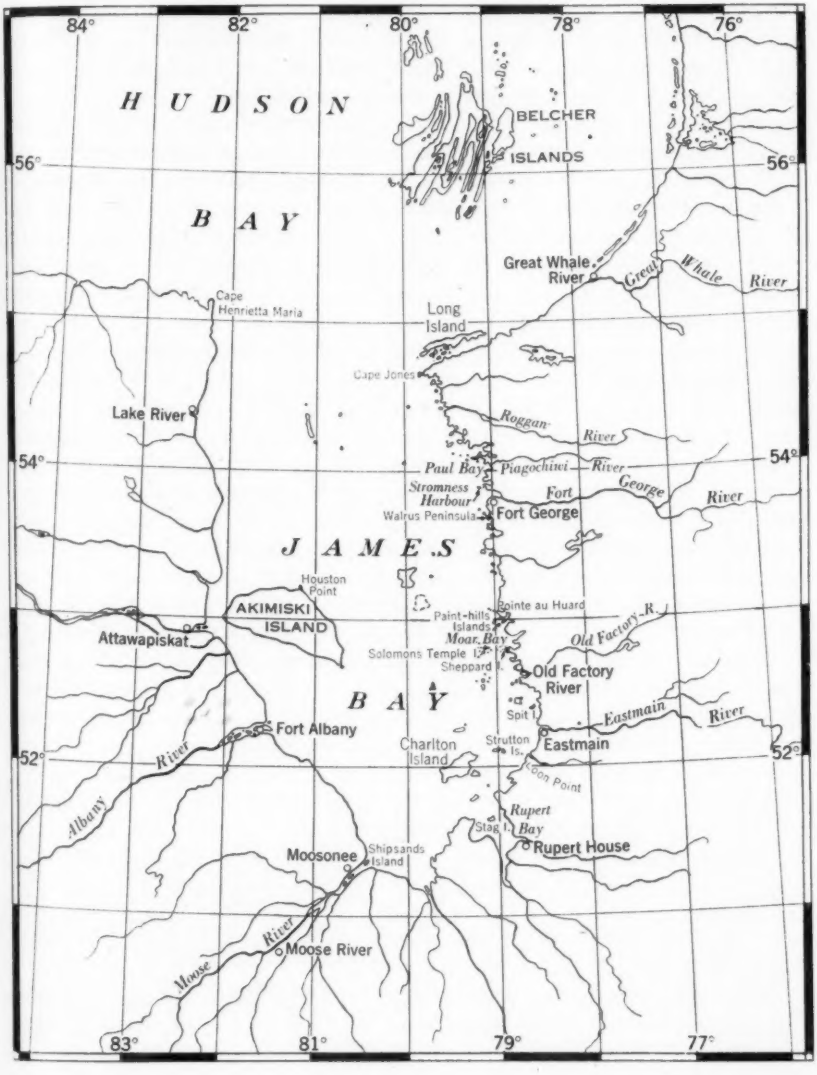


Fig. 2. Plot of tide readings taken at the southern end of Moar Bay to the east of Sheppard Island. The dots indicate scale readings. The dots on July 2 and 3 with arrows pointing downwards indicate readings taken after the level of the water outside the small bay where the scale was situated had dropped below a boulder bar at the entrance to the bay. After July 3 a second scale was set up in the outer bay and used for low water readings. At midday on July 13 the scale was moved to Sheppard Island, about half a mile distant. The break shown in the graph at this time indicates the estimated tidal rise during the hour and a quarter which elapsed while the scale was being moved.

the same period of the lunar phase at Paul Bay. A longer series of readings at these places might negate this.

The change from the synodic tide of northeastern James Bay to the declinational type at Moar Bay probably occurs at the Paint-hills Islands, which, with the Solomons Temple group of islands and the shoals which lie between, might be expected to interfere with the even progress of the tidal undulation.[1] The sudden increase of the lunitidal interval and the apparent decrease in the range in the short distance between Pointe au Huard and the Paint-hills Islands can be seen in Fig. 1. The diurnal inequality of the tides at Moar Bay during the periods of greatest lunar declination is clearly shown

[1]We observed strong currents among both these groups of islands. The only other places on the east coast of James Bay where we noticed strong currents were Cape Jones and the strait between our camp at the south end of Moar Bay and the nearby island.



in Fig. 2. It will also be noted that low water usually occurred in the morning, and high water in the afternoon or evening. One exception was July 8, when it remained low all day. Obviously winds in different parts of the bay would have a relatively large effect on a tide with so small a range. Also, we were camped in a small bay with a narrow entrance lying behind a moderate-sized island, and this may have caused some local irregularities. The diurnal inequality of the Paint-hills Islands tide was not very apparent during our

three days' stop, but its affinity to the Moar Bay tide is indicated by its apparent tendency to be high at approximately the same time on successive days. The lunitidal interval here and at the Paint-hills Islands is therefore of no value except to show the sudden change in tide type.

Our stops at Spit Island and Loon Point were too brief to discover the type of tide at these places. Diurnal inequality of range was not obvious, but the morning high water was distinctly later than the afternoon. On September 4 the morning high water at Spit Island was almost an hour later, and the evening almost an hour earlier than the corresponding highs at Charlton Island ('Tide tables', 1949). On September 5 the Loon Point evening high water was a little later, and the morning over an hour later than the corresponding Charlton Island highs.

It has previously been shown from approximate observations (Manning, 1950) that the tidal undulation travels southeast from Churchill along the southern coast of Hudson Bay, arrives at Cape Henrietta Maria about 8¾ hours later, and then swings down the west coast of James Bay, reaching Houston Point (Akimiski Island) about 12 hours after passing Churchill. Our east James Bay readings indicate that what is probably the same tidal wave reaches Paul Bay and the Roggan River at approximately the same time as it does Houston Point, while to the north and south it may be a few minutes earlier and later respectively.[1] Rough observations of the time of high water at several places on the west coast of Akimiski Island were made in 1947 (Manning, 1950). The current 'Tide tables' (1949) provide a method of determining high and low water at Charlton Island, Stag Island, and Rupert House. The 1931 'Tide tables' (1930) also gives similar data for the Strutton Islands, where the rise is 5¾ feet at springs, and 4 feet at neaps, and high and low water may be obtained by adding 2 hr. 35 min. and 2 hr. 40 min. respectively to the relevant figures for Harwich ('Admiralty tide tables', 1949). Generalizing roughly from these data and those given on the Canadian Hydrographic Service Charts Nos. 5413, 5416, and 5000, it appears that high water at Charlton Island and the Strutton Islands occurs at almost the same time as at Shipsands Island. On the mainland coast near Spit Island it averages the same as at these islands, but becomes progressively later towards the entrance to Rupert Bay, where, at Stag Island, it is about one hour later than at Shipsands Island, and at Rupert House 2 hours later.

Obviously, the figures given in Fig. 1 for the height of high and low water only provide a comparable range for a few stations, since at most places the period of observation covers only one phase of the moon. It is apparent, however, that the greatest range along the east coast of James Bay is near Paul Bay and the smallest near Moar Bay (Fig. 2), even if at the latter place only the highest and lowest tides of the day are considered. The small ranges obtained at Spit Island and Loon Point may have been due in part to

[1]Tide tables' (1949) give the time of high water at Fort George as 1 hr. 25 min. later than Churchill, which would be 13 hr. 50 min. later than the preceding high water. This information is based on partial daytime scale readings at the Hudson's Bay Company's post for 13 days in 1935, and 24 days in 1936 (R. B. Lee, Chief, Tidal and Current Section, in letter).

meteorological conditions, since for adjacent stations at Charlton and Stag islands there is a spring rise of 7 and 9 feet respectively, and a neap rise of 5½ and 7¼ feet respectively ('Tide tables', 1949). On August 4 the range at Fort George (Hudson's Bay Company's post) was about 4 feet. It may be noted in Fig. 1 that while the height of high water at Paul Bay increased towards full moon, the height of low water also increased, so that during the time of our observations there was no appreciable increase in the range at spring tides. It will also be seen that the highest daytime tides occurred before 1100 or after 1800 hours, and the lowest daytime tides a shade earlier, both in the morning and evening.

Driftwood Strand Lines and the Unusually High Tide of October 1949

Several travellers (Manning, 1950) have remarked on the effect of the wind on the James Bay tides, but actual measurements of exceptionally high tides are lacking. Last summer (1950) Mr. A. Thorburn, Hudson's Bay Company's post manager at Fort George, told me that one Sunday morning about mid-October 1949,[1] a northwest gale was accompanied by a tide which the Indians considered the highest in living memory. Mr. Lutitt, who was born at Fort George about seventy years ago and who has resided there and at Great Whale River all his life, was also unable to recall any tide of equal height. This exceptional tide was also observed at other places along the east coast of James Bay. At Old Factory River post, where there is very little normal rise and fall, the water stayed high for most of Saturday and Sunday, and at Eastmain it was said to have risen to within about a foot of the top of the wharf. In 1950 the strand line left by this tide was still easily distinguishable from older strand lines by the dead grass, sticks, and other comparatively ephemeral debris. It could be seen wherever conditions were suitable from Long Island to Loon Point. At Paul Bay, the Paint-hills Islands, and Spit Island, all sheltered from the direct effect of a northwest wind, it was found to be 5½ feet, 6 feet, and 6½ feet respectively above the height of normal summer spring tides. At Paul Bay it was 3½ feet above the edge of the lower limit of the main growth of strand-wheat, *Elymus arenarius*, and approximately the same height had been reached at a number of other places. Where the shore was bordered by alder, the 1949 strand line usually lay half a foot to a foot vertically above the lower limit of the alder, and up to three or four yards horizontally within the alder. In places exposed to the full force

[1]Mr. Thorburn thought this high tide occurred on October 16, but that week-end was a period of neap tides, and the meteorological synoptic chart shows that winds were light throughout James Bay and eastern Hudson Bay and Strait. The actual date of this high tide was almost certainly the following Sunday, October 23, which coincided with spring tides and meteorological conditions which were clearly ideal for driving water through Hudson Strait into Hudson Bay and thence to James Bay. At 1930 EST on Saturday, October 22, the pressure was about 976 millibars in the James Bay area, and a depression which had passed north up James Bay was centred over the Belcher Islands. The following winds were recorded in the area: Moosonee, WNW, force 7; Coral Harbour, N, force 11; Nottingham Island, E, force 4; Cape Hopes Advance, SE, force 8; Resolution Island, SE, force 7. I am indebted to Mr. B. W. Boville of the Department of Transport for this information.

Driftwood strand lines on the north shore of Sheppard Island, looking east, 8 July 1950. The largest pile was left by the high tide of October 1949.

Upper tide scale and camp at Paul Bay, looking west. Photographs taken near high tide on 31 July 1950. The strand line left by the high tide of October 1949 is about two yards within the alder thicket behind the tent.

of the northwest storm, the waves probably threw flotsam two or three feet above the level of still water.

Human memory and judgment, unaided by measurements, are obviously likely to be unreliable in matters of this kind. It would therefore be unwise to take the statements of James Bay residents entirely at their face value and assume that the 1949 tide has been the absolute highest in that region, even since the beginning of this century. Moreover, on the north side of one of the Paint-hills Islands, a strand line about 6 inches above the 1949 line contained pieces of wood in which there were well preserved small nails that could hardly have been more than twenty-five years old. Even so, a tide 5 to 6 feet above normal is sufficiently infrequent to be considered remarkable by the James Bay residents. This casts doubt on Low's estimate (1889, p. 32J) of a rise of 7 feet above ordinary high water on the east coast of Akimiski Island during a moderate gale on 8 August 1887[1] as well as on his theory that all the driftwood strand lines in James Bay could be accounted for by storm tides.

Driftwood strand lines are a conspicuous feature of the east coast of James Bay. Their best development is in the small, open bays which are exposed to north and west winds. Bell (1879, p. 32C) says that the highest of these lines were 30 and, in places, 40 and 50 feet above sea level, and Low (1889, p. 32J) that they were 10, 20, and occasionally 30 feet above ordinary high water. In neither case do the figures appear to result from actual measurements, and they may therefore have been exaggerated,[2] but in 1949, R. W. Packer (in letter) found by instrumental levelling that the highest line of driftwood on the northern side of Solomons Temple Island was 24 feet above high tide on July 15 and 16, just after spring tides. This is about 17 feet above the unusual 1949 tide, or 14 feet if it be assumed that driftwood would be thrown 3 feet farther up the comparatively exposed Solomons Temple beach. The 'Admiralty navigation manual' (1938, p. 352) says that flood level reached on the shore near a cyclone centre is sometimes as much as 15 feet above predicted high tide level. In eastern Canada, however, the maximum recorded height of any storm tide ('Tide tables', 1949) appears to have been on 6 October 1869 in the Bay of Fundy, when the water in Cumberland Basin was raised 6.2 feet above the normal height at perigee springs (Dawson, 1920, p. 27).

Ruling out the possibility of a cataclysmic disturbance, since this would account for only the one strand line whereas there is a series of strand lines

[1]Low (1889, p. 32J) obtained this figure by subtracting 5 feet, which he considered the ordinary rise of tide, from 12 feet which was the depth of water at midnight at the place where he had beached his boat at 8 p.m. Apart from the fact that the ordinary rise at spring tides (8 August 1887 was a spring tide) on the east coast of Akimiski Island is probably more than 5 feet (and the tide may have been unusually low at 8 p.m. as there had been a southerly wind (Low, 1887) during the day), there is the possibility that the anchor had dragged and the boat's position had changed during the night. The difficulty of sounding accurately in the dark from a boat during a gale on a shoal several miles from land is obvious.

[2]Possibly the highest driftwood seen by Low and by Bell has disappeared during the period since their observations were made.

each one only a foot or two above the others, the higher driftwood strand lines of James Bay can only be accounted for by a fall in the sea level of at least 10 feet since their formation.

This explanation of the James Bay driftwood strand lines was first put forward by Bell (1879, p. 32C), who, judging by the rate of decay of spruce wood in that climate, estimated the rise of the land to have been between 5 and 10 feet a century. Bell, however, apparently made no allowance for storm tides, and his estimate of the age of the driftwood is based on the rate of decay for spruce. Low (1889, p. 32J) points out that the upper strand lines consisted chiefly of cedar, a much more durable wood. In 1949 and 1950 on Solomons Temple Island and the Paint-hills Islands, where conditions were suitable for the preservation of the oldest strand lines, we also noted that they were composed almost entirely of cedar.

The origin of this cedar is in itself of interest. Rupert House Indians still make cedar canoes from wood growing near the rivers which flow into Rupert Bay, but the proportion of cedar among recent driftwood is small. Even if a 15-foot tide were to combine all the strand lines except the highest one or two (which are now almost entirely cedar), far fewer cedar logs would be found in it per 100 yards of shoreline than there are in the top strand line. It may therefore be that this highest strand line dates from a time when cedar grew in considerably greater quantity than at present along the rivers flowing into James Bay.

It is to be hoped that the age of the driftwood strand lines in James Bay may before long be accurately measured by tree ring analysis.

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A GERMAN HANDBOOK ON ALASKA

ALASKA. *By* FRITZ BARTZ. *Stuttgart: K. F. Koehler, 1949. 9½ x 6½ inches; 384 pages; illustrations, diagrams, sketch-maps, and folding maps. DM. 28.*

This excellent book is one of a series of *Geographischer Handbücher*, published under the editorship of Hermann Lautensach. The author, professor at the University of Kiel, has spent a total of about nine months in Alaska, during the years 1936 to 1938, when he was studying at several universities on the west coast. His travels took him over most of the more accessible part of Alaska, and he has evidently familiarized himself with most of the pertinent literature, including much published since the war (the latest dates from the summer of 1947) as shown by a list of 214 references.

As the title of the series implies, this book is a handbook in the German sense, that is, a well-organized compendium of existing information on all phases of Alaskan geography, in the broadest sense. It does not pretend to make an original contribution to existing knowledge, but it is the best single summary in this wide field known to the reviewer.

The first part of the book deals with the nature of the land and includes short chapters on the surface forms (according to the Penck classification), the climate, the ice age and the present glacierization, the flora, and the animal life.

In the description of the surface forms, the principal mountain systems are discussed in detail, and the minor physiographic subdivisions by a paragraph each.

The climate is briefly reviewed, with emphasis on the influence of the Pacific, limited to a narrow border by the mountain ranges, and the importance of the relatively cool Bering Sea and the cold Arctic Ocean. The author compares climatic conditions in Alaska with the more favourable climate of Scandinavia, where the warm waters of the Gulf Stream are able to reach a much higher latitude than the waters of the Pacific on the west coast of Alaska, and where the narrowness of the land mass makes it more open to the influence of the ocean.

The section on the ice age and present glacierization discusses the present and past distribution of glaciers, the problem of the "muck" in unglaciated areas, which include most of the interior, and permafrost.

The flora is described for each of the principal ecological divisions: the Pacific coastal forest, the interior forest, the tundra, and the grasslands of the southwest, and the degree of correspondence between the climatic and ecological divisions is evaluated.

The second major part of the book is devoted to the aborigines of Alaska before their contact with the whites. A chapter is given to the archaeological record and its significance, including a mention of the discovery of Yuma and Folsom artifacts. The distribution, differentiation, and origins of the three principal culture types: Eskimo, Athapaskan, and "Northwest Coast" are described, and the effect of the environment on these cultures is discussed.

The third major part deals with the opening up of Alaska by the whites. The Russian efforts at exploration and economic development were primarily directed towards the exploitation of the fur trade. The author ascribes the failure of Russian attempts at further development of Alaska to the distance from the mother country and to the character of the settlers. Some types of manufactures, such as bell-founding, ship-building, and flour-milling which were undertaken early by the Russians, were later discontinued. Russian treatment of the Aleuts is not glossed over.

The history of American rule in Alaska is divided, politically, into the period of Army rule (largely misrule, according to the author), and the period of territorial

government. Economically, it is divided into the time before and after the discovery of gold in the Klondike. The chapter is largely devoted to the history of the geographical spread and increasing complexity of the two principal industries, gold mining and fishing. Some mention is made of exploration and discovery, the conservation movement, and the influence of Alaskan literature on the attitude towards Alaska in the outside world.

The fourth major part of the book is devoted to present-day economic life. It opens with a short chapter in which Alaska's economic position is described as that of a subarctic colonial land. Alaska is still relatively undeveloped, but because of the high degree of technical advancement and comparatively high living standards in certain limited areas, it differs from more typical colonial lands. It has always served primarily as a source of a small number of relatively valuable raw materials. The economy of Alaska, in normal times, is essentially dependent on mining and fishing. The balance of trade has always been in favour of Alaska by about 2 to 1, but the greater part of the profits has remained in the States. The difficulty of securing a steady, sound development without monopoly and without too intensive exploitation has, in the view of the author, been responsible for the continuation of conservation policies.

The remainder of this long part considers the individual aspects of the Alaskan economy, prefaced by a short discussion of one of its most outstanding features: the pronouncedly seasonal character of employment, the only important exception being lode mining.

The fifth major part deals with population and settlements. The author discusses the size and density of the present population, and its very uneven distribution, largely along the main waterways and the railroad. The proportion of natives to whites, their respective distribution and interrelationship is considered. Of the native groups the Aleuts have been affected most markedly, both in numbers and mode of existence, by contact with white civilization, the Indians in the south-east rather less, and the Eskimo least of all. The cultural contacts have increased as the number of the natives decreased, the decrease being due to a higher death rate than among the whites.

The white population is concentrated in relatively few places. Before the Second World War one half were in the panhandle; only 5 to 10 per cent were in the area from the Yukon to the Arctic Ocean. About one-fourth are foreign born, mostly Scandinavians and Finns, and many of the native-born are persons of similar ancestry, born in the Pacific Coast states. There are relatively few women and children. The disproportion between the sexes leads, the author believes, to overvaluation of white women, with unfortunate social consequences. The population is not sedentary, but constantly on the move, and there is a large seasonal migration.

In the author's opinion, low density of population, great distances within the land, isolation from the outside world, and the high living standard in the States discourage people from taking their families to the northland. He believes that strong colonization of districts suitable for agriculture will probably occur only when people can be brought directly from Europe, perhaps from the poorer parts of Scandinavia. He concludes that in Alaska the frontier period has been unduly prolonged. But he considers that it is a "stagnating frontier" because the interior is a mining frontier, not a farming frontier, and because the pioneers of Alaska are predominantly older people without children. These concepts are unlikely to find favour in Alaska, where status as a pioneer is dependent not on permanence of settlement but on distance from settlements and hardships endured.

A short chapter is devoted to the changes in Alaska resulting from the impact of the Second World War. The construction activities early in the war produced a boom in many areas, some of which were hitherto almost empty, particularly in

the Aleutians. Since the war, the boom has continued but its geographical distribution has changed with changing concepts of strategy. The author however almost completely neglects the serious effect of war and inflation on the gold mining industry.

The future development of Alaska depends on sufficient permanent settlers; the seasonal economy must be changed, since Alaska's economic life is caught in a vicious circle: small population–high transportation costs–high living costs–high production costs–small population.

The book as a whole shows signs of careful editing; typographical errors are very few and geographical names are given in their official, rather than in Germanized, spellings. Some of the maps are blurred, and the half-tone illustrations are generally dull. The sentence construction is sufficiently clear to render the text only moderately difficult for a person with an adequate command of the pertinent vocabulary. The paragraphs are not indented, but many key words are italicized and there is an index.

In a book of this scope some errors are inevitable. A few of the more misleading are listed below.

p. 15. The Near Islands are not the only Aleutian Islands without recent volcanoes; nor is it possible to descry two parallel rows of volcanoes anywhere in the chain; the southern islands of the chain, while largely of volcanic rock, do not bear recognizable cones. Aniakchak had a very great eruption in 1931.

p. 16. Kodiak Island is not entirely of strongly metamorphosed rock; it includes rocks ranging from granodiorite to almost undisturbed Tertiary sediments.

p. 95. The main current in Bering Strait flows northward, not southward, most of the year.

p. 142. The promulgation of the Monroe Doctrine was not, of course, by "President Adams", though J. Q. Adams, when Secretary of State during Monroe's presidency, was influential in the formulation of this doctrine.

The map (Figure 19) which purports to show the principal mining districts, omits one major lode gold mining area on Unga Island, shows one near Flat of negligible importance, and omits any indication of the Latouche copper mine.

p. 230. The ownership of gold dredges is not confined exclusively to large companies. In the most efficient operations, the length of the season is nearer eight or nine months than the six or seven months mentioned.

p. 232. One sentence unfortunately gives the impression that gold placers occur in most Alaskan streams.

p. 241. The figures in the table are correct if commas are substituted for decimal points.

p. 243. Chatanika River water is distributed by gravity, not by pumping. Some of the placer mining operations near the heads of valleys in the Circle district do not have a sufficient water supply. "Old beach gravels" have not been extensively worked near Solomon.

p. 247. Copper was produced as a by-product from the Alaska Nabesna mine, not the Alaska Juneau.

p. 249. Production of coal for local consumption appears to be profitable enough.

p. 253. More recent work has shown that oil in northern Alaska is derived from Upper Cretaceous or younger rocks.

p. 254. The areas on the Alaskan Peninsula and near Yakataga, withdrawn from entry under the oil leasing acts during the war, were restored to entry on 14 August 1946, by Public Land Order 323.

p. 333. Circle is not on the Arctic Circle.

p. 335. The Aleut inhabitants of Attu did not return to that island after the war, but settled at Atka. The church on Amchitka was destroyed by military operations.

The map facing p. 342 lacks indication of the relative size of towns.

p. 344. Juneau does possess a capitol building.

p. 349. The first ship to Nome from Seattle generally arrives about June 10, sometimes later. It usually stops at Unalaska.

p. 352. The "Seward Peninsula Railroad" ran for many years as a public tramroad.

ROBERT R. COATS

REVIEWS

DAS ARKTISCHE JAHR

(The arctic year).

By Gottfried Weiss. *Braunschweig: Georg Westermann Verlag, 1949.* 7¾ *x* 9¾ *inches; 163 pages; 37 plates and 41 text figures. D.M. 9.80.*

A fairly complete account of the various German attempts to establish and maintain weather stations in northeast Greenland during the Second World War has been given by Arnold Court in *Arctic* (Vol. 2 (1949) pp. 108–17), and a Danish version of what happened in northeast Greenland between 1940 and 1945 has appeared in 'Det Grønlandske Selskabs Aarsskrift' for 1946 ('The Greenland Society Yearbook').

Two of the seven German attempts succeeded, and during the winter of 1942–3 a German weather station operated on Sabine Ø (74°40N.), and the following winter another was established at Shannon Ø (75°20N.). Both were discovered by members of the Danish East Greenland Patrol and eventually destroyed by U.S. forces, but in both cases the German personnel was successfully evacuated by air.

At the outbreak of the Second World War a couple of hundred Greenlanders and a few Danes and Norwegians became isolated in northeast Greenland. About 225 of these were at Scoresbysund. A small group of Danish trappers and hunters invested with "police" authority occupied the northernmost Danish outposts of Ella Ø and Eskimonæs, four Danish scientists were stationed at Mørkefjord, and finally, about one score of Danish and Norwegian trappers were scattered along the coast between Scoresbysund and Danmarks Havn. A few of the Danish trappers joined the Danish police force, while the remainder, and all the Norwegians, were evacuated to west Greenland. In 1941, under authority vested in the independent Danish Government of Greenland, the small east Greenland police force was organized into the East Greenland Patrol, and given full military status. The force actually consisted of less than two dozen men and was equipped with rifles only. For transportation they depended on dog teams in winter and on small motor boats in summer. In addition to the radio station at Scoresbysund, there were transmitters at Ella Ø, Eskimonæs, and at Myggbukta, but the patrol had no portable radios. Vessels of the U.S. Coast Guard undertook the supply service in summer, but during the ten months of winter the patrol was entirely thrown on its own resources.

In 'The arctic year' Gottfried Weiss, who was the scientist in charge of meteorological work at the German Sabine Ø station, gives what appears to be a straightforward, well illustrated, and most readable account of the expedition which sailed from Tromsø in Norway on 22 August 1942, in the converted German steam trawler *Sachsen* of 284 gross tons. Before its departure a non-stop reconnaissance flight from Norway to northeast Greenland had been undertaken in order to select a suitable site for the weather station. Ice conditions were exceptional in 1942, and the *Sachsen* made the crossing without difficulty, anchoring in Hansa Bugt on Sabine Ø on August 27.

While the *Sachsen* was slowly steaming through the ice pack off Sabine Ø, the U.S.C.G.C. *Northland* was anchored in Gael Hamkes Bugt only 50 miles to the south; luck, however, was with the Germans, for an American aircraft from the *Northland* flew almost directly over the *Sachsen* without seeing her.

In Hansa Bugt the *Sachsen* put into winter quarters, but first her masts were taken out and the superstructure camouflaged. On shore two simple huts were set up, one to serve as weather station, the other as quarters for the 18-man party which, besides the commander, consisted of meteorologists, radio ope-

rators, the ship's doctor, and the 10-man crew of the *Sachsen*. None of them were professional soldiers and only the commander had had previous arctic experience.

The early part of the winter was uneventful and the experience of the party differed in few respects from that of similar expeditions who have wintered in the Arctic under comparable circumstances; the last chapters of the narrative, on the other hand, where the story of the discovery and the subsequent encounter, first with the Danish East Greenland Patrol and later with the United States bombers is told, is dramatic and full of human interest. In this encounter the Danes had the advantage of being quite at home in this vast uninhabited and inhospitable land; they were experienced hunters and travellers, but without training and experience for the new role into which circumstances had forced them which, at any moment, might require them to hunt or even kill fellow human beings instead of seal or polar bear. The Germans, too, were amateur soldiers and had obviously hoped to remain undetected; although much better armed than the Danes, they must have spent the winter in constant fear of detection and surprise attack.

In March 1943 a 3-man sledge detachment of the Danish Patrol returning from a routine patrol of the coast, discovered evidence in a hunting camp at Germania Havn, a few miles south of Hansa Bugt, of a nearby German weather station. Unknown to the Danes a 2-man German hunting party saw the patrol and, under cover of darkness, returned to their base to give the alarm. Several German parties at once set out to capture the patrol. The Danes, however, managed to escape but in doing so had to abandon their three dog teams and travelling gear. Covering the 60-mile distance on foot, and without food and sleeping bags, they reached Eskimonæs and reported their discovery. Meanwhile the Germans, who were quick to take advantage of the dog teams of which they had so unexpectedly come into possession, set out in force to capture and destroy the Danish stations before the alarm could be given. In this they failed, but on the way they ambushed another Danish sledge detachment. One Dane was killed and the remaining two were captured together with their dogs. Not long after one Dane managed to escape and the other, while the main force of the Germans were enroute to Ella Ø, disarmed and captured the German commander, Hermann Ritter, who had stayed behind to guard the prisoner. The Dane, with his, perhaps, not unwilling prisoner, travelling by a different route, reached Scoresbysund.

On May 25 four American bombers from Iceland, under the command of Colonel Bernt Balchen, partly destroyed the German station but apparently failed to see the camouflaged *Sachsen*. On June 17, after scuttling their ship, the remainder of the Germans who had suffered no casualties in the bombing, were evacuated from Sabine Ø by a German "Condor" to Norway. The ship's doctor, who was out of the camp at the time, was subsequently found by a party from the *Northland* on July 23.

A. E. Porsild

TERRE STÉRILE

By Jean Michéa. *Paris: Bloud et Gay, 1949. 7½ x 5½ inches; 221 pages; illustrations, diagrams, and sketch-maps.*

INUK: au dos de la terre!

By Roger Buliard, o.m.i. *Paris: Editions Saint-Germain, 1949. 8 x 5½ inches; 358 pages; illustrations, sketch-map, and folding map.*

APOUTSIAK: le petit flocon de neige.

By Paul-Émile Victor. *Paris: Flammarion (Les albums du Père Castor), 1948. 8 x 10 inches; 32 pages; illustrations. 300 fr.*

Arctic literature has been recently enriched by three interesting books in French which should appeal to all those concerned with northern problems. These books are moreover highly recommended for students of geography and sociology in English-speaking universities who wish to practice French without making it an ordeal.

Jean Michéa is an ethnologist who spent a year and a half among the Caribou Eskimo in the Baker Lake district. Owing to a printer's error, the sub-title of the book reads "Six mois chez les Esquimaux Caribous" instead of "Dix-huit mois". His book, which is in diary form, describes the life of the Caribou Eskimo during the four seasons. The daily routine of the Caribou hunters is described in minute detail and in a simple and graceful style. The book is illustrated with photographs and drawings by the author.

Following the current French practice, Michéa translates *Caribou Eskimo* by *Esquimaux caribous* instead of *Esquimaux du Caribou*. The latter, in my opinion, is the correct form. Concerning the origin of the syllabic Eskimo used by the Eskimo, he mentions that it was invented by the Moravian missionaries of the Labrador coast, who taught it to the Naskapi Indians and to the local Eskimo. In fact, the Naskapi, who are in touch with the north shore of the St. Lawrence, do not use this alphabet. Moreover, I have been led to believe that the alphabet was invented by the Rev. James Evans (1810-46), an Anglican missionary, and was first used in 1841, at Norway House, Manitoba, by the Cree Indians. In spite of such minor differences in interpretation, Michéa's book remains a most fascinating one and is recommended to those in search of a few hours of interesting French reading.

For the same reason, Father Buliard's book should find its way into the libraries of those interested in the Arctic. Father Roger Buliard (there are three Oblate Fathers in the same family, all well known in arctic circles) lived among the Copper Eskimo for fifteen years. When writing his book, he was posted on Victoria Island. The book, which includes pages extracted from the author's diary, describes *Inuk* (singular of *inuit*) the man, the real man: naturally the Eskimo himself. The seasons, the climate, the conditions of sea and land travel are also discussed. The life and character of the Eskimo, together with many minute details give a vivid sense of reality to the narrative. There is much poetry in the description of the changing sky, of northern lights, blizzards, and the pack ice.

The psychology of the Eskimo is analysed in detail. No doubt Father Buliard knows them, but we may perhaps differ with him when he writes that "les Esquimaux n'avaient plus de religion" (p. 82). This is not the impression one gathers from his own description. The Eskimo are animists. They practice shamanism, but no hierarchized religion. This may be what Father Buliard means by an absence of religion. As with all animists, religion remains purely a personal affair.

The author manifests an evident sympathy for his Eskimo. Yet many of his readers, including the reviewer, will perhaps be astonished at the harshness of some of his observations. He is very severe when he insists upon so-called specific deficiencies in the Eskimo which make them amoral individuals, traitors, murderers in fact or in intent.

Ever since Father Buliard left the Seminary he has lived among Eskimo. He knows them well but his comparison suffers because he has lost touch with the recent and unwholesome progress of humanity. Those living in the midst of our own civilization, those reading our newspapers, those who have suffered invasions, or those who have witnessed the bitter "settling of accounts" have a right to question whether the Eskimo are so different from the "civilized" white race.

Contrary to the present tendency among French ethnologists Father Buliard uses the feminine form *esquimaude*, a practice I follow.

Apoutsiak is a little Eskimo boy living in Angmagssalik, where Victor made an ethnological survey in 1934-5. The book consists of a collection of the author's drawings accompanied by a short and simple narrative. The drawings are of artistic quality. Not only do they express good taste, but all details are correctly portrayed. I do not know of any other book which can give children

a more accurate view of the life of the Greenland Eskimo. According to some psychologists my mental age is slightly over twelve, nevertheless I derived great pleasure from Victor's book. Get it for the children and you will doubtless be the first to read it yourself.

JACQUES ROUSSEAU

A GERMAN AND ENGLISH GLOSSARY OF GEOGRAPHICAL TERMS

BY ERIC FISCHER AND FRANCIS ELLIOTT. *New York: American Geographical Society, 1950. (Univ. Press, Cambridge, Mass.). Amer. Geogr. Soc. Library Series, No. 5. 8¼ x 5½ inches; vii + 112 pages. $3.00.*

This little book should do much towards clarification of terms and will help greatly in reading German geographical literature. No dictionary can take the place of knowing a foreign language, but such knowledge rarely includes familiarity with technical terms. With the present trend towards specialization in all fields general dictionaries are of limited use. Students almost invariably pick the wrong meaning in a choice of several, and general lexica cannot keep up with the rapid development of the sciences. All sciences require good technical dictionaries and the present one might well serve as a model of format, make-up, and appearance, as well as content.

There are about 3,000 German terms in 60 pages of German-English and about 2,500 English terms in 50 pages of German-English translations. Many terms are not strictly geographical but they are used in geographical literature and fortunately there are no sharp boundaries between fields of work.

The glossary is well printed and substantially bound and will stand up to heavy use. The authors and the American Geographical Society are to be congratulated upon the appearance of this excellent aid in scientific work.

ERNST CLOOS

NORTHERN NEWS

Hydrographic expedition to the Beaufort Sea

The Canadian Defence Research Board's vessel C.G.M.V. *Cancolim II* left Vancouver on July 26 to carry out hydrographic and oceanographic work in the Canadian Western Arctic. The area of operation will be in the Beaufort Sea north of the Canadian mainland, extending eastward into Amundsen Gulf.

The leader of the expedition is Mr. T. H. Manning, Vice-Chairman of the Arctic Institute. The other members of the party are: Dr. W. M. Cameron, in charge of hydrographic and oceanographic work; Mr. F. G. Barber, hydrographer; Mr. A. J. Dodimead, hydrographic and oceanographic technician; Mr. A. H. Lawrie, biologist; Mr. C. L. Merrill, geographer, also the ship's engineer; Mr. G. F. Hattersley-Smith, geologist and glaciologist; Mr. A. H. Macpherson, biological technician; and Mr. C. MacDonald, cook.

The C.G.M.V. *Cancolim II* is an 80-foot vessel of 82 gross tons built in Vancouver in 1940 for fisheries inspection work. She was requisitioned during the war by the Royal Canadian Navy, in which service she was renamed H.M.C.S. *Flores*. Her diesel engines develop 232 h.p., giving her a speed of 11 knots. She has been refitted for scientific work and provided with additional iron bark sheathing as protection against ice.

As well as the hydrographic and oceanographic program the expedition hopes to carry out fisheries investigations for the Fisheries Research Board, collect birds and mammals for the National Museum and ectoparasites for the Department of Agriculture, gather information on game and fur-bearing mammals, and make astronomical fixes for the Geodetic Survey. At the end of the season it is planned that the party will return south by air, leaving the vessel to winter in the Arctic, ready for further work next year.

Some relationships of plant communities to the physical environment in Alaska

During the summers of 1949 and 1950 I carried out studies on the plant communities in various parts of western Alaska with the aid of a research grant from the Arctic Institute[1]. Particular studies were made of the floristic composition and relationships of the communities to the substratum. Soil profiles were examined and the working and maximum depths of the root systems were determined for a large number of communities from trenches dug in the substratum.

The major communities, such as the several kinds of forest and shrub, strand zones, marsh and bog communities, grasslands, and the tundra complex, are readily recognized. The minor and micro communities present greater difficulties. During the past two summers a number of minor communities have been identified and studied. It was found that stands in widely separated areas often show striking similarities, not only to one another, but also to those in Norway, described by Nordhagen in his monograph on Sikilsdalen.[2] For example, the hummocky marsh complex near sea level at Kotzebue, consisting of dwarf shrubs, sphagnum, mosses, and lichens on the hummocks, and sedges in the depressions, is similar to the stand beside Wonder Lake at 2,000 feet in Mount McKinley National Park, and to the *Oxycoccus microcarpus-Empetrum hermaphroditum-Sphagnum* association at 4,000 feet in Sikilsdalen, Norway. At Kotzebue, in this community, the ground was frozen on 10 August 1949 at 15 to 20 inches below the surface; but at

[1]From funds provided by the U.S. Office of Naval Research.

[2]Nordhagen, Rolf. "Sikilsdalen og Norges Fjellbeiter, en Plantesosiologisk Monografi". *Bergens Museums Skrifter*, Vol. 22 (1943) pp. 1–607.

Wonder Lake no frozen ground was found to a depth of 43 inches (roots to 40 inches) on August 25. Near Nome in similar communities the frozen ground was 10 to 14 inches below the surface.

The dwarf-heath shrub-lichen communities on hillsides northeast of Nome and on slopes at Shungnak near the Kobuk River, are similar to Nordhagen's *Betula nana-Empetrum hermaphroditum-Cetraria nivalis* association. This community is of great economic importance, both in Alaska and in Norway, because of the large amount of winter forage it produces for reindeer, as well as for caribou in Alaska.

Most interesting is the *Kobresia myosuroides - Dryas octopetala - Hedysarum alpinum americanum* community studied in Mount McKinley National Park. According to Dr. Adolph Murie this community is a favourite feeding ground for mountain sheep during the winter. The lime content of the soil was high, the pH ranging from 7.8 near the surface to 7.2 at a depth of 3 feet. The ground was frozen below 38 inches; the roots were numerous to the working depth at 26 inches, with a maximum root depth of 37.5 inches; and snail shells (*Succinea strigata* Pfeiffer) were found to a depth of 35.5 inches. This community is similar to the *Kobresia myosuroides* association in Norway.

Much research is needed on the composition, characteristics, and environmental relations of plant communities in many parts of Alaska in order that they may be classified, related to communities elsewhere in arctic, subarctic, and alpine regions, and used as an aid in land management.

HERBERT C. HANSON

Arctic Dog Disease[1]

In 1947 Dr. P. J. G. Plummer showed that rabies existed in the Canadian Arctic and that there appeared to be a definite connection between rabies and arctic dog disease (*Arctic Circular*, Vol. I (1948) pp. 37–8 and 55–6). It is generally accepted that there are at least two distinct types of arctic dog disease, one resembling distemper and the other rabies. In outbreaks of the disease a diagnosis is possible only by examination of specimens, which should be sent to the Animal Diseases Research Institute, Hull, P.Q.

There are certain precautions which must be taken when shipping both carcasses and sick dogs. If the animal has died of rabies the saliva and urine will be dangerous. The head should therefore be chopped off and placed in a tin, a lard pail is a convenient size, and shipped in such a manner that it cannot leak. The body should be wrapped in sacking and frozen if possible. If rabies is suspected the head alone is required for diagnosis. Live animals must always be treated with the greatest caution.

Before dogs can be moved from the Northwest Territories permission must be obtained from an inspector under the Animal Contagious Diseases Act or a member of the R.C.M.P. This regulation was published in a Ministerial Order of the Department of Agriculture of 11 March 1949.

As a protective measure vaccine against rabies has been sent to R.C.M.P. posts in the Northwest Territories and the Labrador, and as many dogs as possible have been inoculated. As the vaccine affords protection for a limited time only, the inoculation must be repeated, which will be done without charge. All dogs must be inoculated before permission to leave the Northwest Territories can be granted. Distemper vaccine is not supplied free of charge.

Arrangements to ship dogs or carcasses to the Animal Diseases Research Institute, should, if possible, be made through the R.C.M.P.

Uranium prospecting in Alaska

Several field parties of the U.S. Geological Survey are making reconnaissance studies in Alaska this summer as part of a joint Geological Survey-United States Atomic Energy Commission program to appraise the potentialities for uranium

[1]Reprinted from the *Arctic Circular*, Vol. 4, No. 3 (1951) pp. 47–8.

production in Alaska. This work was initiated during the Second World War.

To aid uranium prospectors the Geological Survey has opened a laboratory, at present housed in the University of Alaska, near Fairbanks, where samples will be examined free of charge. The radioactivity of samples will be determined and if uranium is present in sufficient quantity the nature of the uranium minerals will be investigated. Samples should be addressed to: Alaskan Trace Elements Unit, Geological Survey, P.O. Box 1088, Fairbanks, Alaska. In addition Geological Survey field offices at Fairbanks and Juneau will carry out preliminary radiometric tests on samples submitted by prospectors and will forward those of interest to the new laboratory for further study.

Microfilms of M'Clintock journals

The Northern Administration Branch of the Canadian Department of Resources and Development has received a set of three microfilms from Mr. H. F. M'Clintock of journals relating to expeditions made by his father the late Admiral Sir F. L. M'Clintock. The three microfilms are as follows:

(1) Arctic Journal kept by Dr. Scott, R.N. while serving in H.M.S. *Intrepid* under Cdr. F. L. M'Clintock, R.N., 1852–4.

(2) Journal kept on sledge journey by Lieut. F. L. M'Clintock, H.M.S. *Assistance*, 1850–1.

(3) Arctic Journals of Admiral Sir F. L. M'Clintock in
  (i) H.M.S. *Enterprise* 1848–9;
  (ii) H.M.S. *Assistance* 1850–1;
  (iii) H.M.S. *Intrepid* 1852–4;
  (iv) Yacht *Fox* 1857–9, with reports by Lieut. Hobson of journey in 1859 and finding of the Franklin Record, and by Capt. Allen Young of journey in 1859 to Prince of Wales Land.

Further copies of these microfilms can be obtained at a small cost from the Director of the National Library, Kildare Street, Dublin, Eire.

Tuberculosis Survey: James and Hudson bays, 1950[1]

In the summer of 1950 an X-ray survey of the natives living in the area to be served by the new hospital at Moose Factory was carried out by the Indian Health Services of the Department of National Health and Welfare. The area covered included the west coast of James Bay and the east coasts of James and Hudson bays as far north as Cape Smith. Dr. R. N. Simpson was in charge of the Survey and the party included Dr. D. S. Davis, dentist, and Mr. K. Wedderspoon, technician.

The party arrived at Moosonee on June 12 and, after having held clinics at Albany, Attawapiskat, Moose Factory, and Moosonee proceeded to Rupert House by R.C.M.P. Peterhead boat. Clinics were held at Rupert House and Nemiscau, which was reached by aircraft, and the party then went on to Eastmain. There, as at Rupert House, the natives seemed to have many minor complaints which were thought to be the result of poor living conditions prior to the beaver quota. On the way north the party stopped at the Cape Hope Islands and arranged for the Eskimo there to go to Old Factory. At Old Factory the living conditions of the Eskimo were found to be poor since they had had little or no trapping. A beaver quota which has now been arranged should improve their economy. At Fort George, the largest settlement in the James Bay area, 680 X-rays were taken. At this post there are two distinct groups of Indians and a small group of migrant Eskimo. The larger group of Indians, known as Inlanders because they travel inland for great distances to their trapping grounds, are prosperous and healthy, while the smaller group, known as Coasters as they stay near the post when the trapping is poor, as well as the Eskimo, have a lower standard of health.

The party left Fort George on August 1 and, after calling at an Eskimo camp

[1]Reprinted from the *Arctic Circular*, Vol. 4, No. 3 (1951) pp. 45–7.

on the way, reached Great Whale River the following day. The Eskimo there were found to be lazy, shiftless, and poorly nourished as they preferred to hang around the post rather than hunt for food.

After leaving Great Whale River, the party visited the Belcher Islands where three clinics were held: at the trading post on Tukarak Island, at Eskimo Harbour, and at a camp in Omarolluk Sound to the southwest. The Belcher Eskimo are isolated nearly the entire year because of fog and storms in the summer and ice in the winter. The islands are bleak but native food is plentiful and the islanders were by far the healthiest group visited. Apart from the old and crippled there was no sickness and no complaints and the only things the natives were anxious for were tea and tobacco.

After leaving the Belcher Islands, clinics were held at Richmond Gulf, a camp near Taylor Island, Port Harrison, a camp near Povungnituk, and Povungnituk. Eskimo from a camp near the Hazard were taken to Richmond Gulf by the party as the sea was too rough to unload the equipment at the camp. Cape Smith was not visited as the post manager was away and there was no radio communication. The party therefore returned to Port Harrison and left by air for Moose Factory on September 10, having completed 3474 X-rays in the course of the Survey.

At all places visited general health was examined, arrangements were made for the sick to be evacuated to hospital, and dental work was carried out. The following table gives a summary of the results of the X-ray survey:

	Indian	Eskimo	White
Number of X-rays	2419	850	205
Active disease	106	57	8
%	4.38	6.71	3.80
Repeat X-rays %	4.517	5.65	5.37

	No. of X-rays	% Active disease	% Repeat X-rays
Moosonee	143	4.9	9.1
Albany	240	4.2	5.4
Attawapiskat	312	2.2	6.4
Moose Factory	363	2.8	6.6
Rupert House	326	3.4	2.8
Eastmain	142	6.3	4.9
Old Factory	313	4.5	3.2
Fort George	680	4.7	3.4
Great Whale River	190	13.7	8.4
Belcher Islands	159	1.3	3.15
Richmond Gulf	107	10.1	8.2
Port Harrison and Povungnituk	499	5.4	4.4

The following list is taken from the Survey carried out from the *C.D. Howe*:

Fort Chimo	341	3.5
Baffin Island	598	11.4

OBITUARY

Lincoln Ellsworth, 1880-1951

Lincoln Ellsworth, a pioneer in arctic and antarctic exploration by air, and first to fly completely across both polar regions, died on 26 May 1951 following a heart attack. He was in his 72nd year.

A restless desire to see new lands, cross new seas, and to expand earth's frontiers was the expressed motive in all that Ellsworth did. Born of wealthy parents, he decided early in life to devote himself to exploration, and gave up a life of leisure to fit himself to lead expeditions by aircraft, ship, canoe, submarine, dirigible, and on foot to Alaska, the Canadian Northwest, the Andes, and both polar regions. His expeditions were not mere stunts for fortune or self glory, but, in spite of the quiet way in which he organized them, they were often spectacular and in total added much to geographical science and to the record of courageous leadership.

After brief periods at Yale, Columbia, and McGill universities, Ellsworth left college to become an axman on the first Canadian transcontinental railroad survey. Later he was a prospector and mining engineer in Alaska and the Canadian Subarctic. Going to France as a volunteer in the First World War, he qualified as a flier only to have his service curtailed by pulmonary illness. In 1924 he led a geological expedition across the Andes from the Pacific to the headwaters of the Amazon. In 1925, with Amundsen and Riiser-Larsen he attempted a North Pole flight from Spitsbergen, but was forced back after one of the two aircraft was lost. On the return Amundsen stated that Ellsworth with almost incredible hardihood and personal risk had saved the lives of the entire expedition.

In 1927, with Amundsen and Nobile, Ellsworth flew across the North Pole in the dirigible Norge. In 1931, as representative of the American Geographical Society, he flew in the Graf Zeppelin on its arctic flight. For a time he supported Sir Hubert Wilkins' early attempts in the field of arctic submarine exploration. Although the submarine venture was unsuccessful, the association of these two explorers, when directed to the Antarctic, brought geographical results of the highest order. From 1933 to 1939, Ellsworth made numerous flights with Balchen, Hollick-Kenyon, and Lymburner in which he discovered nearly 400,000 square miles of the Antarctic Continent.

His books include: 'The last wild buffalo hunt', 'Our polar flight', 'Search', and 'Beyond horizons'. He collaborated with Amundsen in 'The first crossing of the Polar Sea'.

Although awarded high honours by his own and foreign governments and by scientific and exploring groups, Lincoln Ellsworth remained a sincerely modest man, quick to seek and act on the counsel of his expeditionary associates, whom he chose with care, but yielding to no one his unequalled leadership in courage and determination.

An Appreciation by Sir Hubert Wilkins

There has probably never been a man associated with polar and other exploration at once more fortunate and unfortunate than Lincoln Ellsworth. Much of his good fortune was thought to lie in the fact that he was financially well provided for. His father, believing Lincoln to be dead, left his many million dollar fortune to Lincoln's sister, but she, when Lincoln with Amundsen unexpectedly returned from a long delayed sea plane take-off from the arctic pack ice, shared her fortune with him. Thus Ellsworth was able to afford almost

everything an explorer hopes for, but usually has to beg or earn. Perhaps his greatest misfortune was that very fact.

From his earliest boyhood Lincoln wanted to be a sturdy, bold adventurer, demanding by sheer physical strength, superior skill, and power of mind whatever he desired. That spirit led him, in youth, to an outdoor life in which he developed exceptional physical endurance in spite of indifferent health. In later life, until a fall over a cliff in the Grand Canyon resulted in a head injury from which he never recovered, he would think nothing of taking an afternoon walk of twenty miles to develop an appetite for dinner.

His was, to the end, a lovable, boyish character; shy and reserved, with high ideals, yet somewhat vain, petulant, possessive, and with an enjoyment of notoriety, as is the case with most boys.

Time after time, as much perhaps because of his likeable personality as for his financial aid, he was associated with hyphenated expeditions to the polar regions, with his name behind the hyphen. There was the Amundsen-Ellsworth Expedition to the Arctic, the Amundsen-Ellsworth-Nobile Expedition to the North Pole, and others. At last, it was possible to have The Ellsworth Expedition.

It was on four such expeditions which took place between 1932 and 1939, only two of which were successful, that he alone was headlined. Twice, with Bernt Balchen as his pilot, his plans for various reasons were frustrated. Then, with Herbert Hollick-Kenyon as pilot and navigator, he flew across the Antarctic Continent to within a few miles of his destination and with the physical endurance he had acquired, walked the rest of the journey, pulling an emergency sled behind him.

That flight of 2,100 miles, accomplished according to plan, included landings and stops on the lonely, virgin snowfields to avoid flying under cloud and in stormy weather. Because of it he claimed with the consent of the U.S. State Department, but not as an appointee or under direction of the State, some 300,000 square miles of Antarctica and established the name of Ellsworth conspicuously on the map. Later, in the summer of 1938–9, with J. H. Lymburner as pilot, he flew inland over the Indian Ocean sector of the Antarctic and, recognizing Australia's claim to the foreland, claimed the inland area which no Australian had seen for the United States.

Whether the two Antarctic claims mentioned will be upheld either by the United States Government or by international agreement is for future decision, but they remain a monument to Lincoln Ellsworth's courage and fortitude.

GEOGRAPHICAL NAMES IN THE CANADIAN NORTH

The Canadian Board on Geographical Names has recently adopted the following new names and name changes for official use in the Northwest Territories and the Yukon. For convenience of reference the names are listed by the maps on which they may be found. The latitude and longitude given are approximate only and refer to the first letter of the name except where a precise location is given for a place or a spot height for a mountain.

Borden Island, 89 N.½ and 79 N.½, Northwest Territories (8 miles to 1 inch)
(Adopted 2 June 1950)

Deer Bay	78°	53N.,	104	°30W.	not Dyre (Deer) Bay
Ellef Ringnes Island	79	07	105	25	not Isachsen Island
Prince Gustaf Adolf Sea	78	40	108	45	not Prince Gustav Adolph Sea
Wilkins Strait	78	09	111	20	not Wilkins Sound nor Wilkins Bay

Origin Lake, 86 B/11, Northwest Territories (1 inch to 1 mile)
(Adopted 16 January 1950)

Origin Lake	64°	32N.,	115°	24W.	
Spider Lake	64	32	115	13	

Pond Inlet, 38 S.W. and 38 S.E., Northwest Territories (8 miles to 1 inch)
(Adopted 7 March 1951)

Beacon Reefs	72°	25N.,	79°	15W.	
Black Point	72	42	77	58	
Cape Macculloch	72	29	75	07	not Cape Maculloch nor Maculloch Head nor Maculloch Point
Cape Jameson (Ragged Point)	72	04	74	15	not Cape Jameson nor Ragged Point
Erik Harbour	72	31	76	05	not Eric Harbour
Eskimo Inlet	72	10	79	58	not Esquimaux Inlet
Guys Bight	72	40	76	40	
Maud Bight	73	36	79	25	not Maude Bight
Mount Herodier	72	45	77	50	not Mount Hérodier
Pond Inlet	72	48	77	20	not Ponds Bay nor Ponds Inlet
Possession Bay	73	31	77	24	not Possesion Bay
Tay Sound	72	06	79	00	not Arctic Sound
Utuk Lake	72	31	78	02	not Lake Utuk
White Bay	72	16	79	45	not While Bay
Not adopted					
Mount Possession	73	27	77	53	

Somerset Island, 58 N.W. and 58 N.E., Northwest Territories (8 miles to 1 inch)
(Adopted 5 April 1951)

Macgregor Laird Lake	72°	01N.,	95°	03W.	not McGregor Laird Lake nor Laird Lake
M'Clure Bay	73	39	95	43	not McClure Bay
Mount Croker	73	52	90	43	not Croker Mountain nor Croker Mountains nor Crokers Mountain
Rodd Bay	73	57	90	28	
Two Rivers Bay	73	02	91	30	
Altered application from previous edition					
Fury Beach	72	49	91	54	
Fury Point	72	48	91	55	
Lang River	72	18	94	15	
Peel Sound	72	33	95	55	
Omissions (position taken from previous edition)					
Adelaide Bay	72	43	92	27	Cannot identify
Boulder Point	73	53	95	32	Position uncertain
Cunningham Inlet	73	59	93	42	Off map
Duck Lake	72	46	92	50	Name deleted
Franklin Strait	72	04	95	47	Off map
Mount Arthur	73	05	88	24	Cannot identify
Mount Leo	73	13	88	28	Cannot identify
Pressure Point	73	58	95	40	Off map

Upper Laberge 105 D/14, Yukon (1:50,000)
(Adopted 7 April 1949)

Laberge Creek	60°	54N.,	135°	04W.	